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A CRITICAL ASSESSMENT OF THE
ROLE OF IMPERFECT COMPETITION
IN MACROECONOMICS

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ABSTRACT

New Keynesian models and some models of growth rely on market power for their results. This sole focus on market power as the source for certain macroeconomic phenomena is misguided both theoretically and empirically. New Keynesian multipliers are closely related to standard measures of deadweight loss used in the public finance literature. The theoretical analysis shows that a standard competitive model with taxes exactly reproduces the multipliers in the new Keynesian models, and the empirical evidence strongly suggests that taxes, not market power, will be the far more important influence on explaining short-run fluctuations in GNP. Theory and the empirical evidence suggest that the existence of intellectual property rights is likely to be a more important determinant of innovation than market power. Finally, the paper shows how models that incorporate the cost of market making, durability and dynamic policies, and timing based on the option value of resolving uncertainty can yield more valuable insights into macroeconomic phenomena than can models with market power.

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1.0 INTRODUCTION

Models of imperfect competition have proliferated in the macroeconomics literature.¹ These models have been used in both the business cycle literature, where the emphasis is on Keynesian type short-run movements in output, and in the growth literature, where long run properties of the economy are analyzed. These models involve firms having market power whereby a firm can profitably set price above marginal cost. Although these models have improved and made more realistic our understanding of certain economic forces, I claim that it is too much to expect these models based solely on market power to provide fundamentally new insights into how an economy works and that there are probably better areas to pursue to look for new insights into macroeconomics.²

One reason for my skeptical view on the ability of macro models with market power to add to our understanding of short run movements in the economy is that such models give virtually identical theoretical insights as models with taxes and those models have been around a long time. Taxes create a wedge between price and marginal cost in the same way that market power creates a wedge. It is this "wedge" that drives most of the interesting results in the macro literature dealing with imperfect competition. I will show that many of the Keynesian multiplier results derived from models using monopolistic competition are identical (after appropriate reinterpretation) to expressions of deadweight loss in the public finance literature. Since empirical estimates of these deadweight losses from market power are small,

1 See Matsuyama (1995) and Silvestre (1993) for recent surveys and Mankiw and Romer (1991, vols. 1 and 2) for a collection of papers. Zarnowitz (1992) provides an excellent and insightful overview of all business cycle research.

2 I focus my analysis on models of monopolistic competition with Keynesian type multipliers and on models of monopolistic competition with long-run growth. Models of monopolistic competition may well be useful for analyzing other macro phenomenon.

I am skeptical of the quantitative significance of these Keynesian-type results derived from market power.

Models with market power have been used to study growth. Although these models have yielded some valuable insights, I believe that other forces such as the existence of intellectual property laws may be at least as important a force as market power in understanding growth. The reason for the assumption of market power in models with endogenous innovation is to provide an incentive for innovative activity by creating a property right in the rents generated by any new discovery. But domestic and international laws protecting intellectual property are key determinants of whether such property rights can exist at all. There turns out to be a close relationship between property rights, human capital, and R & D and these relationships provide a much richer background to understand incentives for innovation than one with only market power.

Although I believe the "standard" models of imperfect competition won't generate startling new insights into macroeconomics, models that depart from perfect competition in non-standard ways likely will. Specifically, models that focus on the frictions or costs of making a transaction or that recognize that firms choose "policies" intertemporally which can differ from a sequence of static one period maximization problems strike me as likely to provide promising new insights into how a macroeconomy works. I will explain why the usual notion of marginal cost loses its meaning in some realistic models and why this can help explain certain types of results regarding margins and intertemporal substitution in business cycles. I will concentrate on three areas in which to examine departures from the usual competitive assumptions: markets where sellers face a risk that they can't sell their goods always, durable good markets, and markets where the uncertain future affects timing. These

last two cases belong to a general class of examples in which firms (or the market) choose policy functions over time.

Because I'm not a macroeconomist, I must begin with a caveat. I know enough international trade theory to recognize that it is not my comparative advantage to discuss macroeconomic models. Though I'm familiar with some of the literature, I am not familiar with it all. I therefore apologize in advance if I make a point that has already been made and I fail to cite the appropriate source. I also will try to avoid repeating my views in Carlton (1989) where I discussed much of the literature in industrial organization, especially that dealing with price rigidity, and its relationship to macroeconomics.

This paper is organized as follows. First, I analyze the use of imperfect competition models to derive Keynesian multiplier results. Second, I will discuss growth theory and why understanding the forces leading to laws protecting intellectual property may well be more important for understanding growth than knowing the level of market power. I examine the close relationship between capital intensity, R & D intensity and intellectual property laws. Finally, I analyze three types of departures from the usual model of perfect competition that could yield interesting insights into market clearing and intertemporal behavior.

2.0 MONOPOLISTIC COMPETITION AND THE KEYNESIAN MULTIPLIER

2.1 Relation Between Deadweight Loss and the Keynesian Multiplier

In simple Keynesian models, we have the identity $Y = C + I + G$ where Y is income, C is consumption, I is investment, and G is government spending. If $C = a + bY$ with $b < 1$, and if I and G are exogenous, we obtain the Keynesian multiplier and the familiar result that

$\frac{dY}{dG} = \frac{1}{1-b} > 1$, or that as G rises by \$1, Y increases by more than \$1. This result occurs

because there is an implicit assumption that there is more labor that is willing to work holding wages and prices constant. The implication is that prior to an expansion of G by \$1, that there are unutilized resources -- resources inefficiently idle. The economy was operating inside its production possibility frontier. Indeed, if labor is involuntarily unemployed, then its shadow value is zero (or lower than the value of leisure) and an expansion of output using these unutilized resources generates an enormous amount of income and welfare to the economy. Having otherwise useless resources produce valuable output is what makes Keynesian policy sound great and what leads to Keynesian multipliers of 1 and higher.³

Models of monopolistic competition usually posit that the monopolistic competition is at the final goods level and that all markets including the labor market clear.⁴ This means that unlike the simple Keynesian model, the economy is always on its production possibility frontier.⁵ The distortions that arise under monopolistic competition come from the gap between price and marginal cost for each good in the final good market. According to the reasoning in this literature, fiscal policy can generate marginal profit in the economy which then leads to increased demand for goods which leads to what looks like a Keynesian multiplier.

The analogy to Keynesian multipliers is more apparent than real. Although realistic and insightful, these models that produce what look like Keynesian multipliers have little to do with what I think of as Keynesian macroeconomics and more to do with the public finance

3 It is welfare not GNP that matters to society. Practical considerations of national income accounting preclude the valuation of leisure. I will focus my analysis on welfare which GNP is supposedly designed to measure.

4 Hart (1982) is a notable exception.

5 When monopolistic competition occurs in intermediate goods, there is a distortion in factor usage which places the economy inside the production possibility frontier. This possibility seems not to have generated much interest in the macro literature.

analysis of taxation. Indeed, when I learned macroeconomics at M.I.T., I recall learning about the "Okun gap," the shortfall between potential GNP (achievable if people who wanted to work could) and actual GNP. I also learned about "Harberger triangles," the loss to society from gaps between price and marginal cost caused by taxes. The quip was that it takes many Harberger triangles to equal an Okun gap. The public finance literature reflects the same sentiment when it suggests that the loss from taxes pales in comparison to the loss from unemployed resources. (See, e.g., Musgrave and Musgrave [1980] p. 319.) I view the current Keynesian literature based on models of monopolistic competition as equivalent to claiming that Harberger triangles⁶ are the same as an Okun gap.

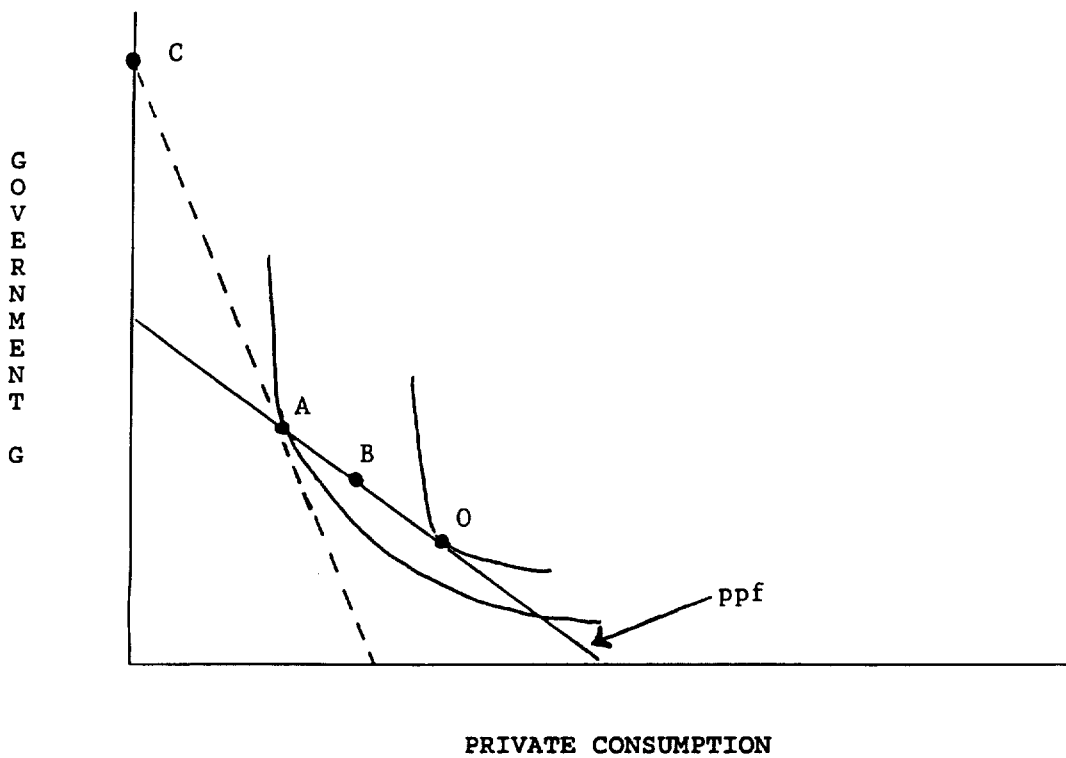
Let me start by taking one of the clearest and most insightful papers in this macroeconomic literature, Startz (1989). In that model, there are three types of goods: private consumption goods available in the market, government supplied consumption goods and leisure. All markets clear so there are no idle resources and society is on its production possibility frontier. There is market power in the pricing of all consumed goods. In the short run, all goods have a constant return to scale production technology (there is a fixed cost to produce, but, once the fixed cost is sunk, returns are constant). Therefore, in the short run, the economy is on its production possibility frontier which is linear among consumption goods.

In Figure 1, I oversimplify (Startz has more than 2 goods, as I already described) to illustrate his key insights. The production possibility frontier is linear with slope c and the economy is on it. No inefficiency from idle resources appear. The economy is at point A because the price ratio between government supplied goods (G) and private consumption is

6 In fact, Harberger "triangles" become trapezoids in markets with existing distortions. See Harberger (1971).

Figure 1

EQUILIBRIUM IN A MARKET WITH MONOPOLISTIC COMPETITION

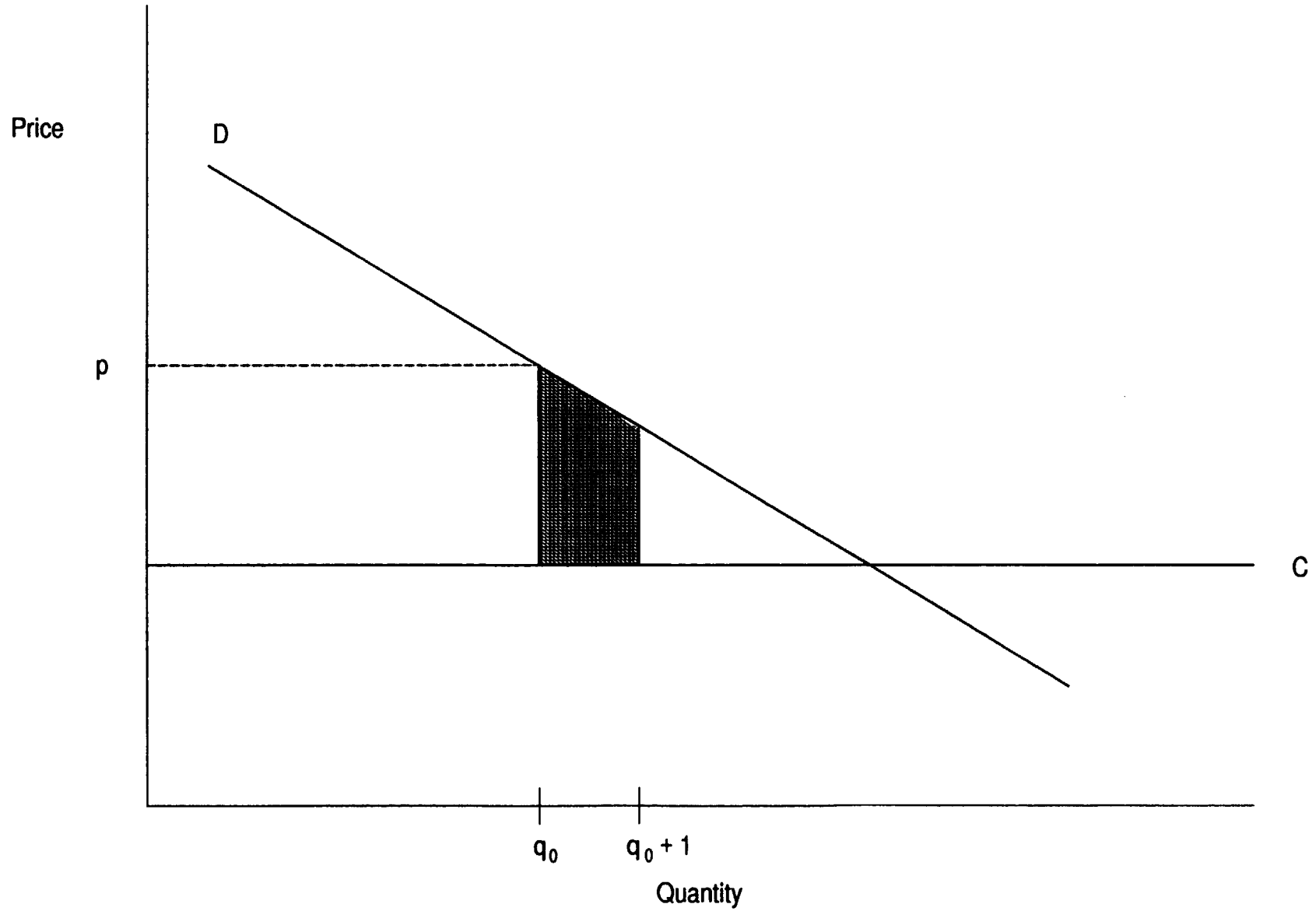


distorted by the presence of market power.⁷ GNP is measured at point C which is based on the price ratio at point A. Welfare for infinitesimal movements from A to B can be measured by seeing what happens to the intercept of the line drawn through B, parallel to AC. As should be clear, GNP (and welfare) rises as the economy moves from A to B. The move from A to B expands output of private consumption, reducing output of G. This leads to an increased GNP because the relative price of private consumption is distorted causing the economy to be away from its optimal point O. (It may sound odd for fiscal policy to involve reducing G, but that is an artifact of my ignoring leisure in this simplified model. In Startz's model, an expansion of both G and private consumption occurs relative to leisure as fiscal policy improves welfare). The increase in GNP from a reduction in G (which I take as numeraire) that expands private consumption by 1 unit is $\Delta \text{GNP} = \text{the lost value of G (which is -c) plus the value of the increased output of private consumption (which is just p)}$. Hence, GNP rises by $p-c$, exactly the gap between price and marginal cost as a result of fiscal policy. More generally, with labor involved, there will be an increase in welfare, just as in the simple Keynesian case, but because the labor market is undistorted and clears, we do not have a zero (or low) shadow value for labor as is implicit in the usual Keynesian analysis and therefore should not expect as large a welfare gain as we are used to from Keynesian analyses.

This "Keynesian multiplier" of Startz's model and the many models like his in the macro literature turns out to be nothing more than a typical Harberger triangle. In Figure 2, I show the Harberger triangle of deadweight loss associated with the gap between price and marginal cost and note that the change in the triangle from increasing private consumption

7 In Startz's model, leisure rather than G is the undistorted good but that doesn't affect the point of the diagram. A three-dimensional diagram would yield the same insight.

Figure 2
DEADWEIGHT LOSS



from q_0 to $q_0 + 1$ is a reduction in deadweight loss of $p-c$, exactly as above. In Startz's and others' models, the increased GNP from expanding output in one market increases demand in other markets, which in turn increases demand elsewhere, and so on.⁸ This is why the effect of fiscal policy is said to create a Keynesian multiplier. However, this multiplier is exactly the same as the Harberger loss "triangle" plus what Harberger calls "trapezoids" which represent the output shift in other markets (with distortions) caused by output shifts in the original market.

This result between the equivalence of the Keynesian multiplier from the macro literature using models of imperfect competition and the deadweight loss literature in public finance should in fact be exact even in more complicated models. Let t_i be the distortion between price and marginal cost for good i , q_i be quantity of good i consumed, and let Z be any government policy. Then, Harberger (1971) shows that the instantaneous change in welfare from altering Z is given by: $\sum t_i \frac{dQ_i}{dZ}$ where $\frac{dQ_i}{dZ}$ is the total derivative of Q_i with respect to Z taking into account all general equilibrium effects that will alter Q_i . (Diamond and McFadden [1974] derive similar formulas using duality theory.) I suspect that every demon-

8 The deadweight loss measures welfare changes. Changes in GNP would also measure welfare changes if leisure were appropriately valued. There is a simple relationship between changes in deadweight loss and changes in GNP when leisure is not valued. The change in welfare, as measured by the change in deadweight loss, equals the change in GNP plus the change in the value of leisure. Although the multiplier results in the literature focus on changes in GNP, I will focus on changes in welfare, since that is the more relevant measure.

stration of a "Keynesian multiplier" in this market power literature can be reproduced by this formula for incremental deadweight loss.⁹

So what, you may ask? There are three main implications. First, the formula shows that these Keynesian results emerge because there is a gap between price and marginal costs, not because markets don't clear. These results are identical to those that emerge in a competitive economy with taxes. That is, if I know how a competitive model with taxes works, then I know all about "Keynesian multipliers" from this new macro literature. Maybe that's perfectly sensible, but I doubt that's what Keynes thought or what most "new" Keynesians believe.

Second, this new macro literature naturally focuses attention on market power as the reason why fiscal policy can improve welfare. Yet, the deadweight loss from taxes are likely as great or greater than the deadweight losses from market power.¹⁰ Most attempts to measure the deadweight loss from market power in the U.S. economy produce small estimates as a percentage of GNP. Harberger's original estimate (1954) of loss was tiny (less

9 Again, if GNP omits leisure, then changes in GNP differ from the formula just given by a term involving the change in the valuation of leisure. It also immediately follows that insights from public finance will be applicable to new Keynesian multipliers. For example, Proposition 3 of the Aloi, Dixon and Lawler paper in this volume follows immediately from the public finance theorem that the incremental deadweight loss of taxes in an undistorted economy is zero.

10 Any regulation or policy that causes price to diverge from marginal cost would also cause a deadweight loss. As a technical matter, the comparisons that I present of the calculations of deadweight loss from monopoly and from taxes have the flaw that each calculation ignores other distortions. The precise calculation of interest is the relative contribution of taxes and market power to the incremental distortions between prices and marginal costs. Roughly, that relative contribution is given by the square root of the ratio of the relative deadweight losses reported in the economic literature for each distortion taken separately. Although it is possible for even small amounts of market power to generate significant distortions in the presence of existing distortions (e.g., taxes or regulations), that has been neither the theoretical nor empirical focus of the new Keynesian economics. Instead, that focus has been that market power alone produces Keynesian multipliers.

than 0.1 percent of GNP), though subsequently there have been much higher estimates. Scherer and Ross (1990) summarize their best estimate based on the entire literature as around 1.3 percent of GNP. Of course, changes in this measure of deadweight loss as a result of government policy will be much smaller and it is changes that are of interest to Keynesians. In contrast, the deadweight loss from various taxes (corporate, income and the like) have been estimated in a higher range. For example, Harberger (1966) estimated the loss from corporate taxes alone to be about 0.5 percent of GNP (over 5 times his deadweight loss estimate from market power). Here too subsequent estimates have increased Harberger's loss estimates. Boskin (1972) finds that taxes on capital (of which corporate taxes are the most important) amount to about 2 percent of GNP. Gravelle and Kotlikoff (1989, 1993) find values 7 to 15 times higher than Harberger. Aside from corporate taxes, there are income taxes. Harberger (1974) estimates the cost of labor taxes to be around .2 percent of GNP, double his estimate of loss from market power. A subsequent estimate by Browning (1979, p. 333) of the loss from the income tax is around 1 percent of GNP. Ballard, Shoven and Whalley (1985) estimate a cost of all taxes in the range 4 to 7 percent of GNP. Although there is considerable uncertainty regarding each of these calculations of deadweight loss, it is likely that the aggregate losses from taxes dwarf those from market power. Therefore, before worrying about market power and how it affects efficiency and output fluctuations, I would first worry about taxes which, unlike market power, are probably easier for a government to affect.

To provide some additional perspective on the importance of market power in the U.S. economy, I calculated the market share of the top four firms (four firm concentration ratio) for

U.S. manufacturing in 1987.¹¹ Focusing on manufacturing, I find that about 60% of U.S. industry has a four firm concentration ratio below 40 percent, while only about 10% of U.S. industry has a four firm concentration ratio over 70 percent. (Compared to 1935, this represents a less concentrated industry structure.) Moreover, industry sectors such as services, retail and wholesale trade are likely less concentrated than manufacturing. My assessment is that there is just not enough market power in the U.S. for it to be the key to understanding macroeconomics. Moreover, notice that the positive Keynesian effect on welfare would completely disappear if the firms with market power practiced perfect price discrimination for then there would never be a gap between price and marginal cost. Thus, in order to believe that there is a significant Keynesian effect on welfare, one must believe not only that there is sufficient market power to generate large deadweight loss but also that the ability to practice price discrimination doesn't seriously mitigate the distortionary effects of market power.

The third implication of the equivalence between Keynesian multipliers and deadweight loss deals with the relationship between the long and short run. In a model with taxes, the tax causes a distortion typically in both the short and long run. In Keynesian models with monopolistic competition, the Keynesian multiplier can vanish in the long run. The models that generate Keynesian multipliers with monopolistic competition distinguish between short and long run. In the long run, the fixed costs of entry of new firms dissipates any profit earned from expanding output. That is, in the long run, the extra gain from expanding a distorted market (i.e., one with a gap between prices and cost) gets dissipated by the real cost

11 There are many drawbacks to using market shares at the four digit SIC Code level as reported by the Bureau of the Census to measure market power. See Chapter 9 of Carlton and Perloff (1994). For the purposes I use these numbers, I believe the drawbacks are not severe.

of entry. This is one of Startz's (1989) most interesting results. This means that there is no Keynesian multiplier in the long run. All short run multipliers come from the extra profit from expanding production in a distorted market, and none from expanding employment of idle resources, since there are no idle resources. In the long run, not only are there no idle resources to use, there is no extra profit from expanding output. Hence, the multiplier vanishes. One crude way to understand this result is that each firm in the long run has constant average costs which become its long run marginal cost. With constant long run marginal costs, there is no pricing distortion between price and long run marginal cost, so there is no deadweight loss or alternatively no gain from expanding output.¹²

If the multiplier disappears in the long run, then it is only in the short run that government fiscal policy can positively affect income. But, this assumes that only the government and not firms can identify when fiscal policy is desirable. That is, suppose the economy is at some point A so that short run fiscal policy can move the economy to B. If firms realize that the government will engage in such a program, firms will enter in anticipation of this action and turn the "no long run multiplier result" into a "no short run multiplier result." This is, of course, the insight of Lucas (1972).

2.2 Empirical Analysis

The fact that Keynesian multipliers in the new macro literature are just plain old deadweight loss is, in some sense, a detail. As I have stated earlier, taxes probably contribute as much if not more to gaps between price and marginal cost as does market power. Regard-

12 I ignore, as does most of the Keynesian literature, the subtle issue regarding optimal product variety. The use of the change in GNP as a welfare approximation to the change in utility is reasonable as long as consumers equate price ratios to their marginal rates of substitutions. New products change this analysis and their introduction means that welfare analysis based on changes in GNP can be inaccurate.

less of the source for the gap, the deadweight loss formula does tell us quite a lot about how short run fluctuations are likely to influence GNP. Economies with high taxes and lots of market power in sectors where output fluctuates a lot should have more pronounced business cycles than those in economies with no taxes and no market power, all else equal.

I have some snippets of suggestive evidence on this issue. (The analysis is highly preliminary.) I obtained annual information from OECD for about 25 years on real GDP and the importance of taxes (measured as taxes collected divided by GDP) for 9 countries.¹³ I regressed the log of real per capita GDP on a time trend. The variability of the residual, all else equal, is a measure of the cyclic sensitivity of the countries' GDP. I examined whether that variability was related to the importance of taxes. Theory predicts a positive statistically significant correlation, but I do not find such a relationship in my admittedly small data set.

I would suggest at least three further directions for empirical work. First, the crude analysis could be applied to more countries and refined to analyze output movements by sector and relate those movements to the distortion between price and marginal cost caused by either taxes or market power. Second, one may wish to distinguish between output and input market distortions.¹⁴ Taxes on inputs cause inefficient production, so that the economy operates within its production possibility frontier. My intuition is that "Keynesian multipliers" and hence the value of output fluctuations will likely be larger if an economy is well within its production frontier than if the economy is already on its production frontier. Finally, the evidence suggests that the shocks hitting the different countries are very different. In order to test the theory, it is necessary to adjust somehow for the size of the shocks. One rough way

13 Australia, Canada, France, Italy, Japan, Netherlands, Sweden, U.K., and the United States.

14 Basu (1995) has explored some of these issues.

to do this is to look at nearby countries, or countries amongst whom international trade is important, and see if the theoretical predictions are more likely to hold for those countries.

3.0 GROWTH AND INTELLECTUAL PROPERTY

Macro models with market power have been used to understand growth. These models use market power to create an incentive for innovation. This section explains why intellectual property laws may be at least as important in understanding innovation as market power.

It has long been understood that no firm will spend resources to innovate if other firms can free ride by quickly and costlessly imitating the innovation. There are three main ways to create a property right in the revenue stream generated by the innovation in order to mitigate the free riding problem.

First, the firm can implement the innovation in such a way that it is hard for other firms to copy. This leads to trade secrets which firms can take steps to protect by controlling access of employees to information. However, protecting trade secrets is costly, can impede the efficient deployment of new technology and, many times, is not cost effective (Kitch [1977]). I have not seen models used in the macro literature explicitly based on protection of trade secrets.

Second, if the firm has market power so that it faces few equally efficient competitors, then competition will not drive price down to marginal cost after the innovation, and the innovating firm will be able to reap some of the benefits of the innovation.¹⁵ The lower is the amount of competition faced by the innovator, the greater is the incentive to innovate. This

15 There is a subtle point here. Market power can be the result of an innovation that is hard to copy. Market power, by itself, does not guarantee that innovations can be protected.

approach, usually attributed to Schumpeter, has been used to understand growth in the recent macro literature (see e.g., Aghion and Howitt [1992], and Grossman and Helpman [1990, 1994], and Romer [1990, 1994]). These models have yielded impressive theoretical insights, though I'm less certain that any empirical link has yet been established between growth and market concentration. Indeed, at the microeconomic level, it has been difficult to reach consensus on what levels of industry concentration fosters the greatest innovative activity (see e.g., Cohen and Levin [1989]). Moreover, often the theoretical models take the degree of market power as given and stable, rather than modeling the dynamic probabilities of being leapfrogged by competing innovators. Still, these models have improved our understanding of growth.

My main question about this literature is how the theoretical insights that it provides regarding market power and growth can be used empirically. If market power is the driving force in these models, do these models have, as would appear, widespread implications for a country's antitrust policy towards mergers and joint ventures? Perhaps at some general level, but practically not really. The reason is that for most joint ventures or mergers and most industries, R & D is not very important nor is market power.¹⁶ Moreover, the theory provides no guidance as to the most desirable levels of industry concentration to foster growth. Our ability to predict empirically how R & D will be affected as industry concentration rises through moderate ranges (which involve most joint ventures or mergers) is poor or nonexistent (Cohen and Levin [1989]). In any event, any prediction would require a detailed empirical analysis of the particular industry. Indeed, I think it unrealistic, except in unusual cases, to expect government agencies to be able to reliably predict the effect of joint ventures or mergers on R

16 Research joint ventures formed to achieve efficiencies, as distinct from simply achieving market power, raise issues that would require separate analysis.

& D. (See Carlton [1995].)¹⁷ Nevertheless, there are some very important policy issues that these models of growth and market power raise but of which I have seen relatively little discussion in the macro literature -- namely intellectual property rights.¹⁸

The third way to protect the investment by innovating firms is to grant them property rights in their intellectual property (e.g., patents) not only in their own country but in other countries. Indeed, the strength of the laws governing intellectual property will be a major determinant of the likely degree of competition and resulting market concentration in an industry where innovation is possible. Just like market concentration is the endogenous outcome of a market process, the laws governing intellectual property also will be the endogenous outcome of a political process. What is interesting is that there should be a close theoretical relationship between concentration, growth, intellectual property and government funding. Some initial investigations suggest that these relations are empirically valid and strong. (Ginarte and Park [1995] and Scalise [1996].)

Intellectual property laws create various benefits and costs for different groups within and across countries. Understanding the importance of these various interest groups helps to predict where intellectual property laws will develop.

There are several major beneficiaries of laws protecting intellectual property. They are:

1. The innovators for whom property rights allow them to earn a reward on their innovation.

17 Some empirical literature on innovation (e.g., Bernstein and Nadiri [1988]) suggests that the social rate of return to innovation exceeds the private rate. This would indicate that antitrust actions aimed at diminishing the ability of innovators to earn profits (e.g., certain Section 2 actions under the Sherman Act in the United States) could be undesirable.

18 Helpman (1993) and Grossman and Helpman (1991) are exceptions in the theoretical literature and Ginarte and Park (1995) and Scalise (1996) are exceptions in the empirical literature.

2. The suppliers of factors of production to the innovating industry, especially when those factors generate rents.
3. The innovating country whose exports of innovating goods can better the terms of trade that the country faces.

Even in the complete absence of domestic laws preventing free riding on others' intellectual property, as long as free riding internationally is difficult, there could be an incentive for the government to support and subsidize R & D in order to encourage innovative products that get exported. For example, even if domestic competition is fierce and there are constant returns to scale so that, in the presence of free riding, any gain from a cost reducing innovation is passed on to consumers, the government could levy a tax on the industry allowing the government to capture in tax revenues the profits from the innovation. This amounts to taxing R & D exports when the innovating industry exports much of its output.¹⁹ One group likely to benefit from such R & D subsidies is universities which can be expected to push for greater research money. We therefore can add as beneficiaries of stronger intellectual property laws:

4. Universities and research personnel.
5. Governments that subsidize R&D and tax industries that export R&D.

Offsetting these benefits are costs. The major one is that consumers will be deprived of the lower prices that free riding firms can charge in the short run.

To empirically investigate the relationship of intellectual property (IP) laws to other economic variables, I use the index system of Ginarte and Park (1995). They classify the strength of IP laws on a scale of 1 to 5 and provide an analysis of IP laws (see Appendix 1 for

19 Presumably, it is politically easier to levy a tax when most of the tax is to be paid by foreign consumers.

a detailed description). I also draw on some innovative work by Scalise (1996) who is investigating determinants of IP laws.

It is well known (Figure 3) that there is a relation between per capita GDP and the capital labor (K/L) ratio.²⁰ Figure 4 shows the relation between per capita GDP and the level of IP protection. The figure shows that there is the same type of positive correlation of per capita GDP with IP laws as with the K/L ratio. In fact, one should expect that with strong IP laws, firms should be willing to hold more capital since innovative capital can be better protected. Figure 5 confirms that there is a positive relationship between the K/L ratio and IP laws. The more capital per worker, the stronger are laws governing IP. Because there is a strong positive relation between human and physical capital across countries (Figure 6), it follows that IP laws are stronger where there is more human capital. It is well known that growth and human capital are related (Mankiw [1995]). Similarly, growth and IP laws are positively related. (Fig. 7) Moreover, as Ginarte and Park (1995) have shown, there is a positive correlation between IP laws and R & D in a country. Finally, in Figure 8, I illustrate the relation between IP laws and government support of R & D. Figure 8 confirms the hypothesis that government spending on R & D and strong IP laws go together.

I believe that understanding the relation between IP laws and income (or growth) is at least as important as understanding the one between market power and growth for three reasons. First, IP laws are likely more important than market concentration in explaining income or growth. That is, if one redrew the figures using industry concentration instead of strength of IP laws, I would expect a weaker relationship. Second, even if one thought that industry concentration was the key determinant of innovative behavior, one would still want to

20 My data uses countries from the Summers and Heston data base (1990). Appendix I reports an OLS regression for each relevant figure in the text.

Figure 3
Per Capita GDP vs. Capital-Labor Ratio
1990

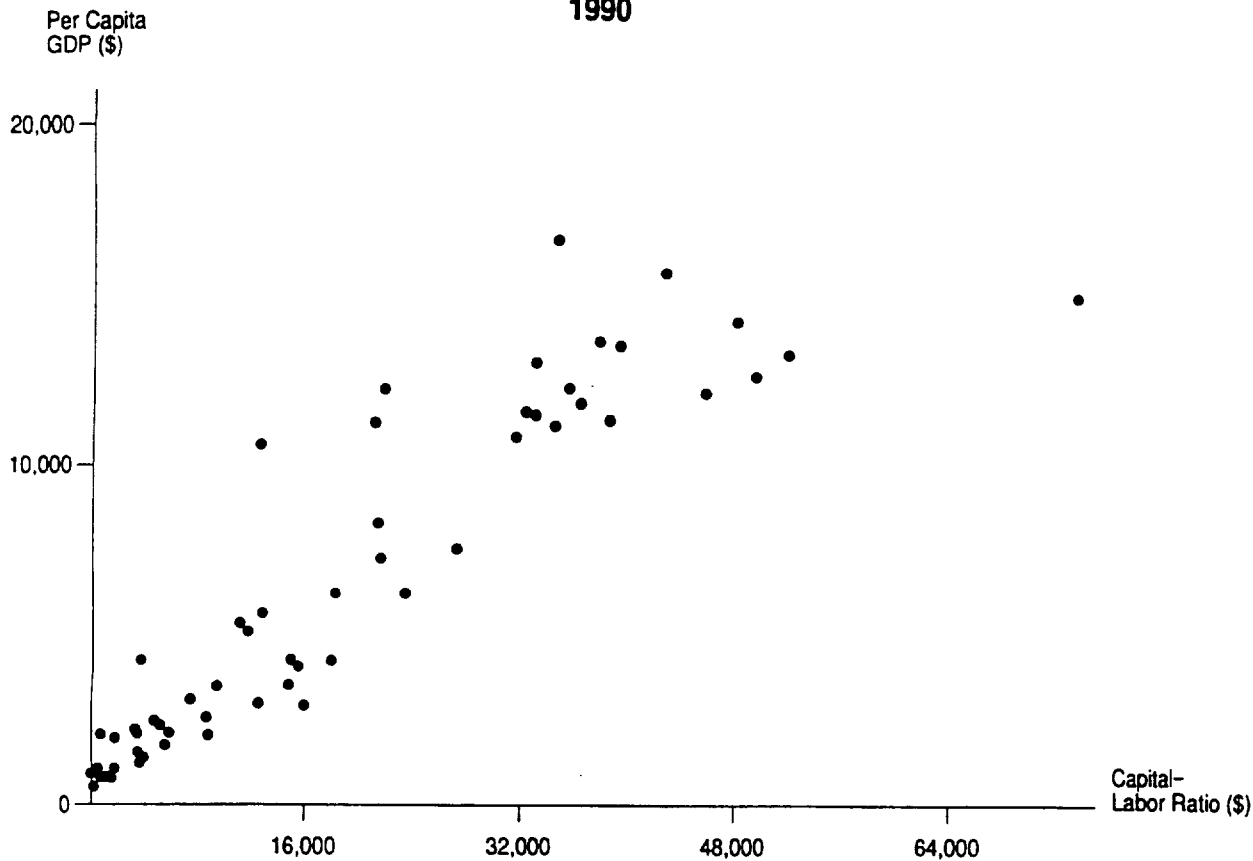


Figure 4
Per Capita GDP vs. Intellectual Property Rights
1990

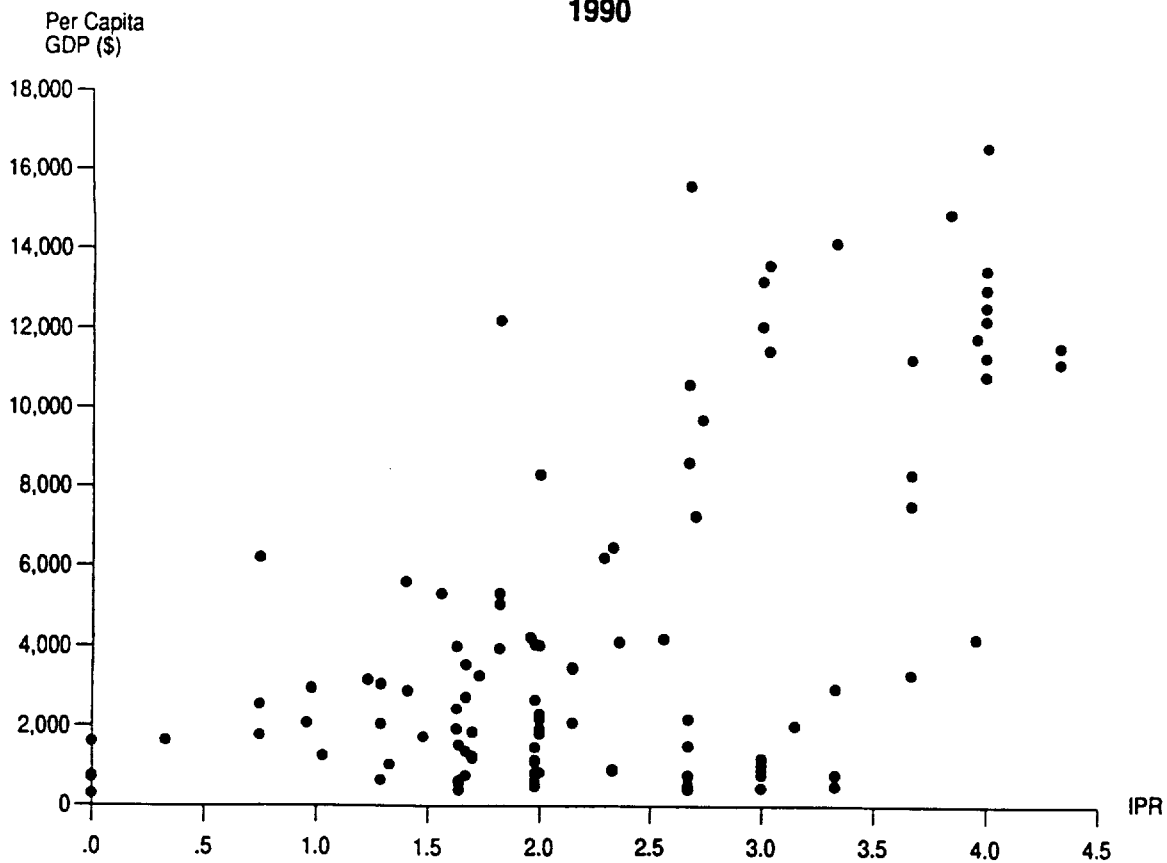
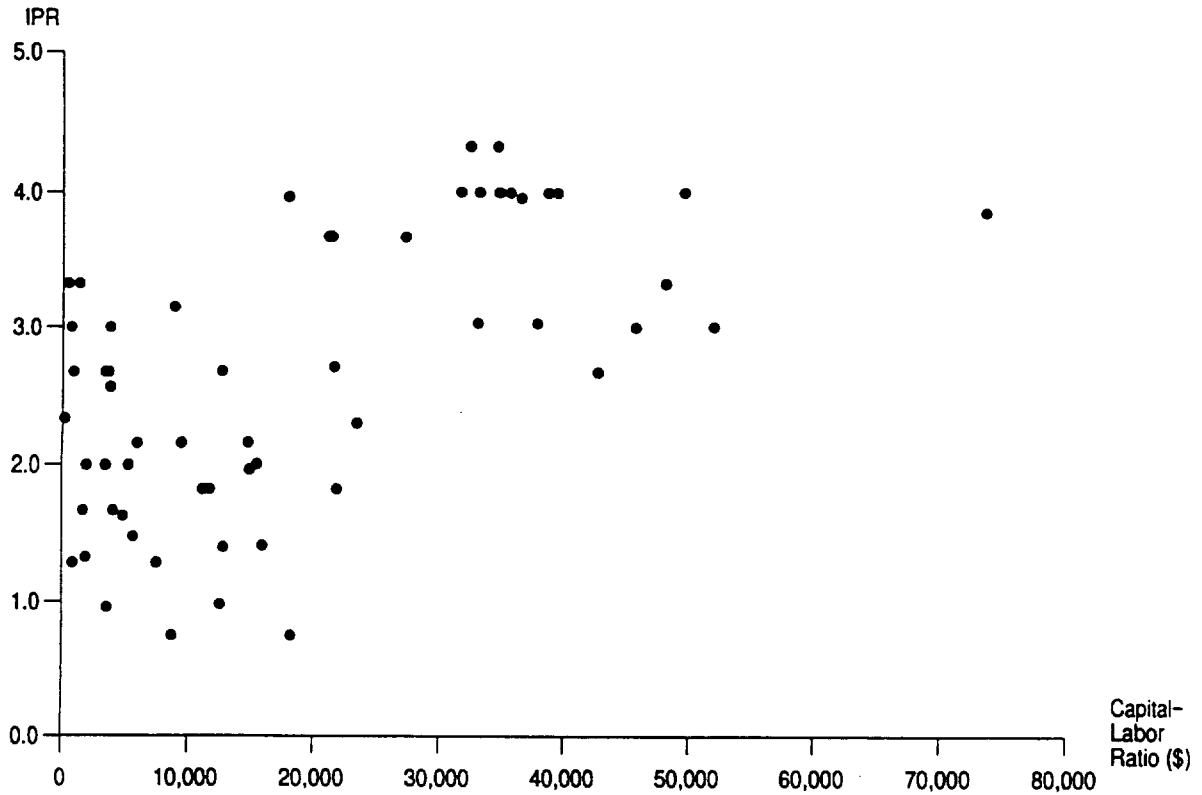
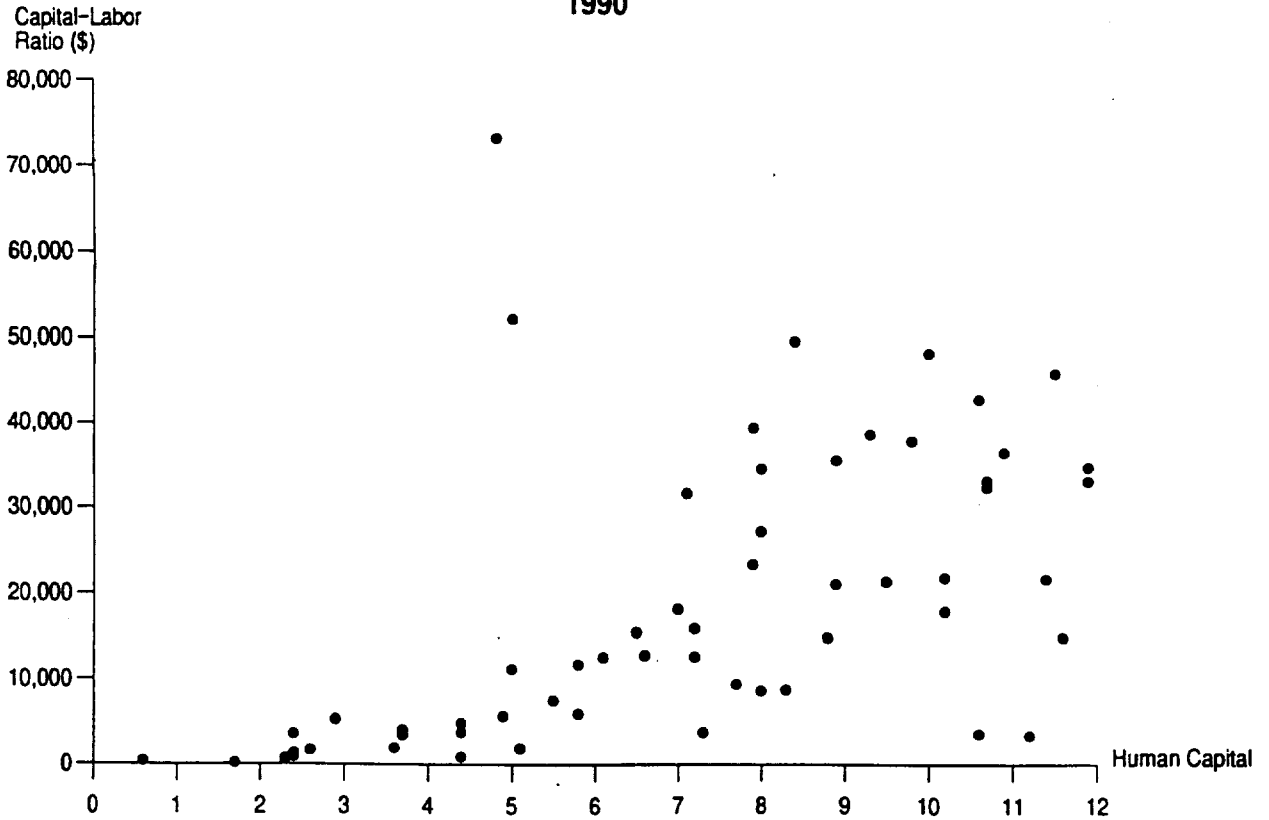


Figure 5
Intellectual Property Rights vs. Capital-Labor Ratio
 1990



Sources: IPR from Park (1995); Capital-Labor Ratio from Summers and Heston (1990).

Figure 6
Capital-Labor Ratio vs. Human Capital Per Capita
 1990



Sources: Capital-Labor Ratio and Human Capital from Summers and Heston (1990).

Figure 7
Per Capita GDP Growth vs. Intellectual Property Rights
1960-90

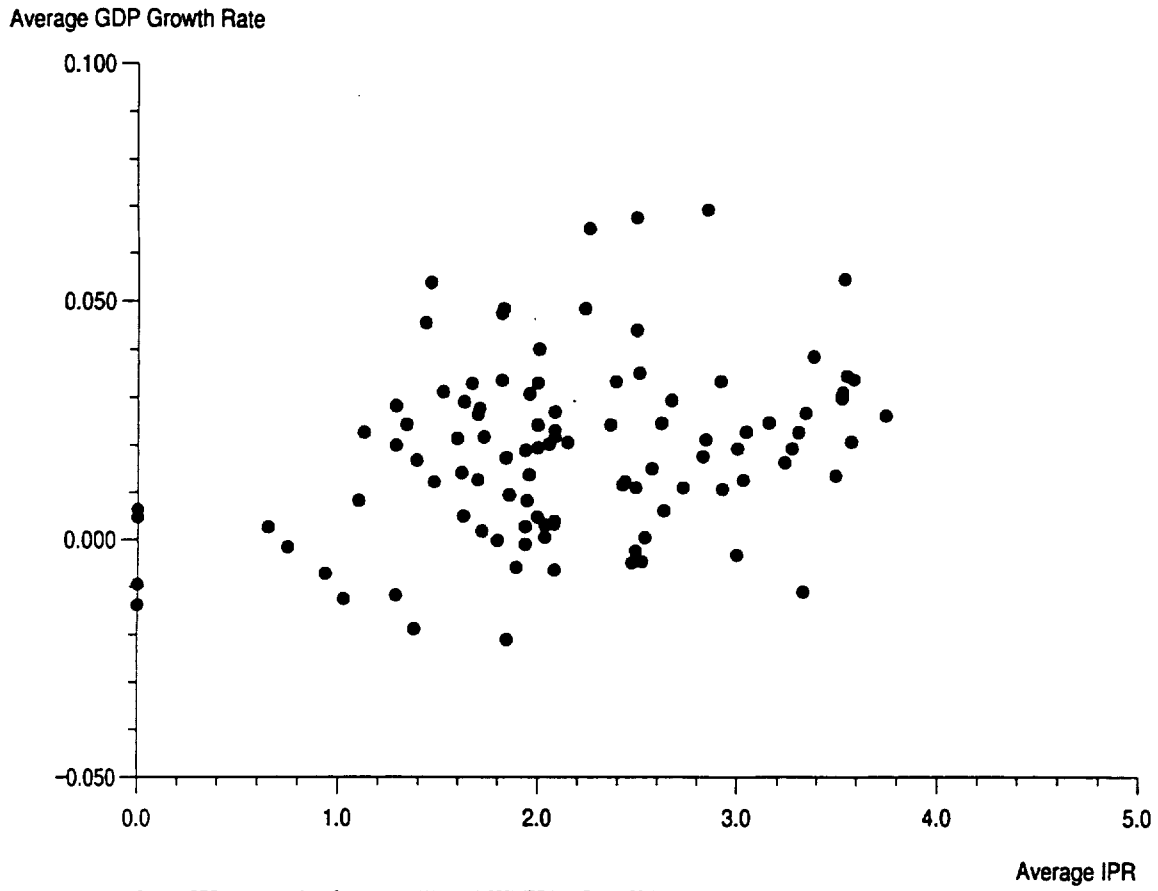
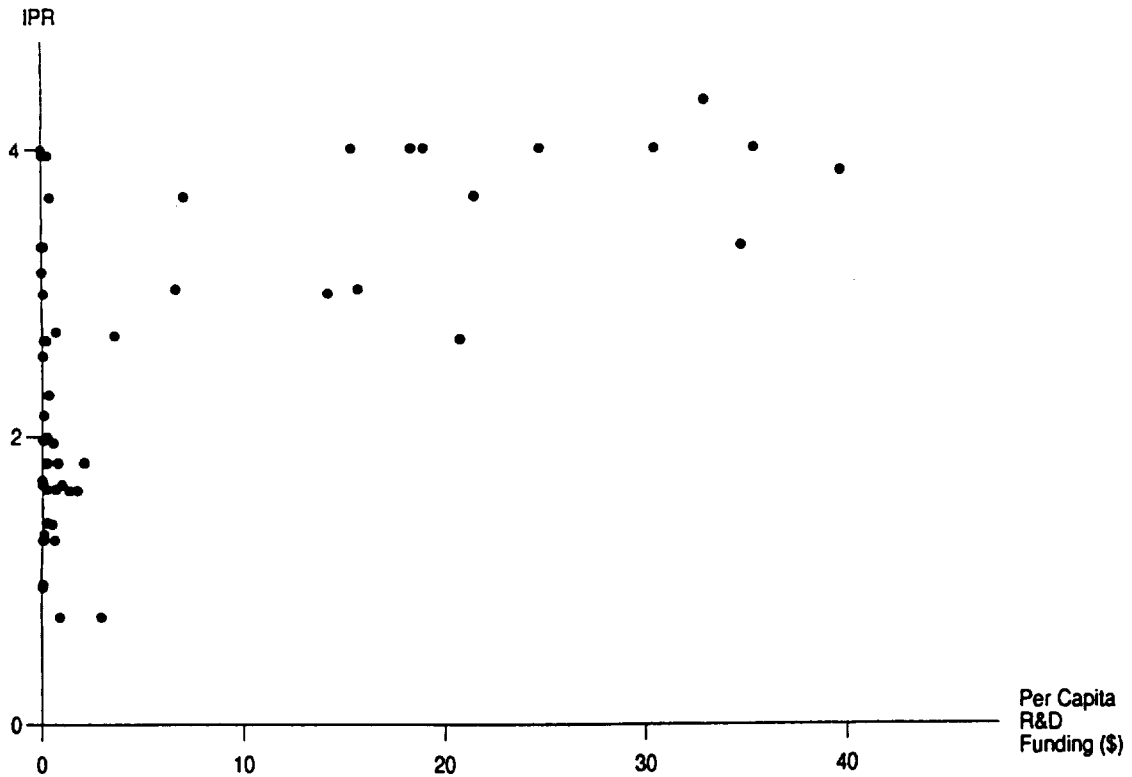


Figure 8
Intellectual Property Rights vs. Per Capita Higher Education R&D Expenditures



understand the determinants of IP laws because of their likely significant influence on concentration. Third, from a policy perspective, IP laws can often be more easily changed than industry concentration. Concentration can mainly be influenced by antitrust or industrial policy and neither policy has proven particularly adept at fostering growth (Carlton [1995] and Klenow and Irwin [1996].)

4.0 THE DEVIATIONS FROM PERFECT COMPETITION NOT INVOLVING MONOPOLISTIC COMPETITION

I am skeptical about the contribution to macroeconomics of models of imperfect competition because of a) their likely small quantitative significance based on deadweight loss calculations (especially compared to other distortions such as taxes), b) their assumption that all markets clear, and c) their ignoring of uncertainty. In this section, I explore three types of deviations from perfect competition that are likely to have greater ability to provide insight into macroeconomic phenomena. I will first focus on the transaction technology in the absence of market clearing. That is, if an auctioneer is not clearing markets for free, how costly and efficient are alternative mechanisms and what properties would an economy with such markets have? Second, I will focus on intertemporal substitution in the durable good sector. Third, I will focus on intertemporal substitution in the timing of investment. These three factors seem to me to contain the keys to questions that several macroeconomists pose such as why some resources appear not to be fully utilized and why there are business cycles. I do not mean to suggest that the topics I discuss are the only deviations from perfect competition important for understanding macroeconomics. For example, a key channel for understanding business cycles involves the credit market, a topic I do not discuss. (See Bernanke [1983]).

4.1 Non-Walrasian Market Clearing

4.10 A Simple Model

With the same constant returns to scale production technology available to all and with perfectly divisible products, each consumer becomes self-sufficient and produces everything for himself. In this Robinson Crusoe economy, there is neither resource misallocation, resource underutilization nor business fluctuations. Once we introduce comparative advantage, we obtain worker specialization and trade. Economists have grappled with the notion that in the absence of costless Walrasian auction markets, the trading mechanism is what causes a macroeconomy to differ in performance from that of a Robinson Crusoe economy.²¹ The idea of round-about production mattering is perhaps a reflection of this notion. There are many alternatives to an auction that have been explored, such as consumer search (Stigler [1961], Diamond [1982]), fixed price models (Matsuyama [1985, section 3]) and a hybrid of the two (Prescott [1975], Eden [1990]). I will focus on only one such model and then on only a stripped down version in order to highlight its salient features (see Carlton [1977, 1978, 1989, 1991], Deneckere and Peck [1995], Greely [1996] for more detailed analyses).

As a general matter, economists have spent relatively little time studying the distribution sector -- the sector responsible for allocating goods -- even though wholesale and retail trade contribute about 17 percent to GNP, a figure close to manufacturing's share of about 22

21 Before feeling forced to abandon the competitive paradigm, one should make sure that the competitive model is not consistent with the facts. The real business cycle literature exemplifies this approach. In Carlton (1983, 1989), I discussed how certain phenomena that look like non-Walrasian behavior such as delivery lags and relatively inflexible prices are perfectly consistent with a competitive economy. (See also Zarnowitz [1962].) Specifically, I stress the virtually ignored role of delivery lags as a (Walrasian) clearing device and show how important delivery lags are as a determinant of demand. However, I do go on to explain why market clearing models leave several facts unexplained. I return to the importance of delivery lags in Section 4.11.

percent. To stress the role of the distribution sector in achieving efficiency, I note that distribution comprised only 7 percent of GNP in the economies of the former Soviet Union in the early 1990's. (Joskow and Schmalensee [1994]. See Carlton [1991] for a discussion of the role of making markets.)

Imagine a model in which a firm must set its price and choose its capacity before it knows its demand. A bakery could be a simple example, though more generally many firms set price and leave it unchanged for quite lengthy periods exceeding one year in many cases. (See Carlton [1986].) In such a model, it is natural for buyers to be unable occasionally to purchase the good and for sellers to be unable occasionally to utilize fully their capacity. The likelihood that the good is available becomes an endogenous characteristic of the good that matters to buyers. The likelihood that the good goes unsold matters to sellers.

To set up one simple model, imagine that the number of customers that arrive is N and that each customer has a demand $x(p)$. Let N be a random variable with mean u and variance σ^2 . Customers care about both the price and the probability of obtaining the good. For simplicity, assume that consumers go only to the firm that yields them the highest expected utility. (Allowing search would not alter the basic results.) An equilibrium consists of a price and capacity choice by each firm that yields zero expected profits and maximizes a consumer's expected utility. In equilibrium, competitive firms take the utility level as given. (These models can be formulated as a game theoretic model in which the equilibrium I've described is the limit as the number of firms gets large. See Deneckere and Peck [1995].)

To understand the firm's choices, write the firm's profits as

$$\Pi(p, S) = \left[\int_0^S P \cdot i \, dF_i + PS \int_S^\infty dF_i - cS \right] x(p)$$

where S is the maximum number of customers that the firm can serve, $F(i)$ is the cumulative probability that i or fewer customers arrive, and c is the constant cost of capacity. For simplicity, I assume that, if capacity is available, the firm can produce the good at no additional cost. There are several important implications of this model.

First, because it occasionally happens that goods go unsold -- some capacity is purchased but is not ultimately used -- the cost of those unsold goods (or the capacity to produce those goods) must still be paid for. Hence, the price of goods sold must exceed c in equilibrium! The gap between p and c is not a result of market power, but rather is a reflection of the transaction technology of the model. In equilibrium, each firm takes the utility level as given and so has no market power. Regardless of why the gap between p and c occurs, it follows that a certain expansion of output by 1 unit raises output by p and cost by c , adding to GNP by the amount of the gap.

One can use this model to assess the recent attempts to measure the gap between price and marginal cost and attribute the gap to market power.²² For example, the attempts by Hall (1988) to measure market power by examining the Solow residual may correctly measure the gap between price and marginal production cost but incorrectly identify the source of that gap. Hall observes that marginal production cost, x , equals $\frac{\Delta L}{\Delta Q} W$, where W is labor and ΔL and ΔQ are changes in labor and output respectively. In competition, $p = x$, while with monopoly, $p \cdot u = x$ where u differs from one and equals $u = \left(1 + \frac{1}{E}\right)$ where E is

22 See also Rotemberg and Summers (1990) and Eden and Griliches (1993).

the elasticity of demand. Hall can solve for u as $\frac{\Delta L}{\Delta Q} \frac{W}{P}$. Hall calculates u for several industries and obtains estimates for u significantly different from 1, leading him to conclude that significant market power exists in the U.S. economy.

To put the model that I have just sketched into Hall's framework, imagine that if a customer shows up, then an additional cost, a , is borne for each additional unit sold as the cost of using some additional input L . Suppose that one additional unit of L is needed for each additional unit of output. Then in equilibrium, price equals $a + \gamma c$ where $\gamma > 1$

because price must cover the cost of unsold capacity. Hall would calculate u as $\frac{a}{\gamma c + a}$ and

would attribute the deviation of u from unity to market power, even though there is no market power in the model in the sense that each firm takes the consumer's utility as given. Indeed, as a approaches 0, Hall's measured market power rises to infinity. The model underscores how tricky the concept of marginal cost can be. Although c is the cost of producing one more unit, c is not the expected marginal cost of producing and selling one more unit. Indeed, in this non-Walrasian model, that cost of selling depends on the characteristics of demand and the existing capacity.

The second implication of the model is that there are two separate decisions for the firm to make, price and capacity, even in competition. These two choices will influence how intensively the capacity is used. In contrast, in a Walrasian model, the firm has only one choice variable and there never is an inability to sell nor is there underutilization of capital. In this model, unlike a Walrasian model, "idle" resources sometimes exist (unsold capacity) but serve a (probabilistic) purpose of being there when they are needed. It would be wrong to

characterize this "idleness" as necessarily inefficient unless there is a reorganization of production that, given the same transaction technology, can leave everyone better off.

Third, the gap between price and marginal production cost will depend on consumer preferences for obtaining certain delivery of the good and on the underlying characteristics of probability distribution of number of customers, N . Specifically, as the ratio of the mean (μ) to the standard deviation (σ) of the random variable N rises, the transaction technology becomes more efficient in the sense that the gap between price and cost diminishes, for any probability of availability. The fact that σ influences cost creates a true technological externality in the model.²³

One way to view a boom is as an increase in demand. The model tells us that if μ/σ rises in a boom, as is likely, the transaction technology becomes more efficient and the gap between price and cost should narrow. The model would therefore predict countercyclical margins over the business cycles for those markets where auction markets aren't used -- which would tend to be retail markets.²⁴ The empirical findings of Murphy, Shleifer, and Vishny (1989) support such an inference.

Finally, the model has implications for how shocks might get transmitted throughout the economy and why positive demand shocks might get short-circuited in a recession. Consider how an increase in demand usually gets transmitted in a Walrasian economy. After hitting the initial market where a price increase mitigates the quantity shock, the quantity shock leads to

23 A more sophisticated extension of the model (Carlton [1991]) examines how the externality can be controlled and how control of the externality can lead to a theory of marketing.

24 One reason why μ/σ rises initially in a boom is that an initial demand surge raises average demand across products. The boom then encourages entry of new products which entails a sunk entry cost. When the economy falls back down to a recession, the new products remain causing μ/σ in the recession to be lower than μ/σ in the boom.

increased demand for inputs. In the model just described, there is no mitigating price effect on quantity but there is a mitigating stock-out effect. If the firm in the output market that sees a positive demand shock is stocked out, then the positive demand effect is stopped dead in its tracks. Therefore, the inventory holding policy of each stage of production is critical to understanding how forcefully a shock gets transmitted. If u/σ is low in a recession, that will tend to lead to higher stock-outs,²⁵ which will tend to prevent positive demand shocks from being transmitted. This could explain why an economy finds it hard to get out of a recession.

4.11 Extensions of Non-Walrasian Models

The simple model discussed in the previous section, though helpful for understanding certain features of business cycles, is inadequate for providing a foundation for business cycles because it has no intertemporal linkages. There are at least three ways to create such linkages. First, the information at time t can influence predictions at time $t + 1$. Greely (1996) has successfully used this approach to develop a rich theory of business cycles possibilities. Second, a shock today can be dissipated over time at different rates depending on the willingness of consumers to wait.²⁶ As I have explained elsewhere, Carlton (1983, 1989), waiting is actually a Walrasian response that turns out to have enormous significance empirically, though I have rarely seen it used in empirical macro models. The simple idea is that in response to an increase in demand, either price could rise or consumers could wait for

25 I have not examined empirical evidence on this matter. The relevant test would allow the number of products to differ between the beginning of the boom and the beginning of the recession. I suspect that stock-outs in some industries might be more of a problem during booms than busts.

26 The pathbreaking but often overlooked work by Zarnowitz (1962) is especially noteworthy.

delivery or both. In general, the more willing consumers are to wait, the more stable is price. Finally, inventory holding can create intertemporal linkages.

The welfare properties of these models are complicated for two reasons. First, there is no insurance market to allow an individual to insure against the event of being unable to obtain the good. Second, there is a true technological externality in the model. The variability of one individual's demand raises the cost to everyone else. Both these reasons lead to market outcomes that lack the usual optimality properties of a Walrasian competitive equilibrium. See Carlton (1978) and Greely (1996).

4.2 Durables

Durable goods have received much attention by researchers in business cycles (e.g., Murphy, Shleifer, Vishny [1989]). The reason is simple, as Figure 9 shows. The production of new durable goods fluctuates enormously over the business cycle, plummeting in busts and skyrocketing in booms. Why, as Figure 9 shows, is the behavior of durables so different from that of non-durables? I focus on two features of durables: intertemporal substitution, and the lack of an incentive to cut price in a bust for fear that it will adversely affect the firm's reputation for a price policy. The adverse effect of a price cut on reputation impairs the firm's ability to earn a profit (Coase [1974]) and to obtain a steady stream of demanders. This reputation effect arises only where firms have some market power and so only applies to those durable goods industries with some market power. This effect from market power is different from the usual effect, discussed in Section 2, of pricing above marginal cost.

Figure 9
Relationship of Durable Goods to GDP



4.21 Durables and Intertemporal Substitution

Consumers of durable goods receive a flow of services from their stock of old goods plus their purchases of new goods. The demand curve for new goods is derived from the consumers' demand for a flow of services. Even if that flow demand curve reflects no intertemporal substitution (so that the flow demand $q_t [R_t]$ does not depend on R_t for $i \geq t + 1$ where R is the implicit rental rate on capital goods), the demand for new goods will.²⁷ The demand curve a supplier sees, based on the price (not rental rate) of the new good will look highly elastic. Consumers can initially substitute away from new goods and let their old stock supply them. Through such substitutions, as well as keeping and maintaining old goods a little longer, consumers can respond to even a slight price increase in new goods by dramatic movement away from new goods. The elasticity for new goods will be especially high when the stock of old goods is high relative to the annual purchase of new goods.

Three implications follow from the characteristics of the demand for new durable goods. First, any economy wide shock gets reinforced by durables. For example, a slight positive shock can get magnified into a large positive quantity movement for new durables, because the demand is highly elastic.

Second, the price movements in both the new and used market should be small relative to quantity shifts between new and used goods. We have already seen the large quantity shifts in new goods in Figure 9. Figure 10 provides some very rough confirmatory

27 Suppose Q_t = stock of goods at t , N_t = new goods at t , δ = depreciation rate, r = real interest rate and P_t = price of new goods at t . Suppose P_t is expected to remain constant. In equilibrium $N_t = \delta Q_t = \delta Q^*$ where Q^* = the consumption service demanded of durables at a rental price $(r + \delta) P_t$. If P_t rises, and is expected to remain high, $N_t = Q^* - (1 - \delta) Q_t$. As long as Q^* is large relative to N_t , the elasticity of N_t will be high. For many durable goods, the ratio of old to new goods is very high, leading to a very high demand elasticity for new goods.

Figure 10
**Ratio of New Car Price to Four Year Used Car Price
for the Cadillac Sedan Deville
1969 - 1995**



Source: Red Book Used Car Valuations

evidence on new and used prices for one model of car. (Results for other models were similar.) It reveals that the price ratio of new to used cars does not show the large downward movements during severe recessions (e.g., 1975, 1981) that one might otherwise expect.²⁸

Third, although the demand for new durables is highly elastic in the short run, in the long run as depreciation wears down the existing stock, the demand must become more inelastic. As Murphy, Shleifer, and Vishny (1989) explains, this provides a natural reason why a recession ends. Consumers, at some point, can wait no longer and must replace their durables.

4.22 Durables and Price Reputation

The intertemporal substitution story just told made no mention of market power. Although I've explained why market power in general seems an unlikely source of new insight into macroeconomics, some of the work in durable goods monopoly may be an exception to that general rule.²⁹ Durable goods tend to be produced in industries that are more concentrated than nondurables in the sense that a greater fraction of output in durables is produced in industries where the four-firm concentration ratio exceeds 40 percent.³⁰ Coase (1972) and a huge subsequent literature have explained why a monopolist of a durable good gains by following a stable price policy in order to create a reputation that he will not cut price. Indeed,

28 It is beyond the scope of this paper to explain the shape of the curves in Figure 10, but that would appear to be a valuable line of research.

29 It is an exception in the sense that it provides a new theoretical reason why prices fail to fall. I am unsure of its empirical importance. Using data on U.S. concentration ratios and value of shipments for 1987, only about 5 to 10 percent of durable output is from industries with four-firm concentration in excess of 70 percent, though about 40 percent is from industries with four-firm ratios above 40 percent.

30 Surprisingly, the average four-firm concentration ratio is roughly the same for durables as nondurables.

in the United States, you see auto companies advertising how much of the original value a car maintains as it ages. The reason is that the amount a consumer is willing to pay for a durable good at time t depends on the asset's price in the future. Consumers will be willing to pay less today for a new good if prices are expected to fall in the future and thereby reduce resale value. Failure to develop a reputation that price will not be cut will erode the monopolist's ability to earn profits. In general, the monopolist concerned with his price reputation should follow a less variable price policy than one with no reputational concerns. This means that in a recession, the monopolist will be reluctant to cut price even though it may be profitable in the immediate short run to do so because to do so would destroy his reputation of following a stable price path.

This reasoning suggests that the margins in concentrated durable good industries should be countercyclical. It explains why firms should be reluctant to cut price to stimulate demand in a recession. (It is probably more accurate to say that the margins are more countercyclical than one would otherwise expect. I've already indicated that demand for durables is likely to be less elastic as a boom begins so that price should rise in booms, all *else equal*, in the presence of market power.) The evidence on margins in concentrated durable industries supports the empirical implications of the theory just sketched. Margins in concentrated durable good industries appear countercyclical (or acyclical) and, in any event, appear much less procyclical than margins in other industries.³¹

31 The evidence on margins in general is not clear cut. See the discussion in Chapter 9 of Carlton and Perloff (1994), Domowitz, Hubbard and Peterson (1986, 1988), and Murphy, Shleifer and Vishny (1989). My interpretation of the evidence is that margins tend to be countercyclical based on the work by Mills (1936) for the Great Depression. Murphy, Shleifer and Vishny (1989) find countercyclical margins, using recent data. However, Domowitz, Hubbard and Peterson (1988) use recent data to find that with the exception of durables in concentrated industries, margins tend to be procyclical.

This example explaining why a monopolist's desire to establish a price policy can constrain the incentive to cut price is more general in its application than to just durable goods. Anytime either demanders' or suppliers' actions affect future demand or supply conditions, the behavior can depart from simple static optimization and can lead to systematic cyclic behavior such as countercyclical margins. Let me provide an example.

Consider a group of consumers who wish to purchase a nondurable. Some consumers care little about whether they consume in the first or second period. Other consumers arrive only in the second period. A monopolist is trying to figure out how to price his product. There are two periods and the game repeats itself so the monopolist can develop a reputation for how he prices. Assuming that interest rates are zero, in a world of certainty P_1 must equal P_2 where P_i is the price in period i .

Now suppose that although P_1 is known, P_2 is uncertain because the monopolist's costs in period 2 are unknown or hard to predict because marginal cost is upward sloping and the number of customers is random in the second period. If P_2 is random, then the probability distribution of P_2 will affect purchase decisions in period 1. Even holding the mean of P_2 constant, the monopolist who puts a lot of weight in the tails of the probability distribution of P_2 will induce consumers in period 1 to wait until period 2 to purchase. The reason is that as long as the indirect utility function (or profit function in the case of a buyer who is a firm) is concave, Jensen's inequality creates a preference for randomness. But the monopolist may have good profit-based reasons to prefer not to switch consumers intertemporally. For example, spreading out demand over time could lower his costs³² or could allow him to intertemporally price discriminate. The monopolist may choose not to lower price too much in

32 Why can't he induce consumers to consume in period 1 if it is cheaper? He can, but remember his savings are based on differences in marginal cost, while his inducements will affect his marginal revenue.

period 2 in order not to create a price policy in the second period with a probability distribution with fat tails. This reputation for not having a wildly random price in period 2 allows him to maximize his profit even though it may be socially desirable to cut price. This discrepancy between the private and social incentives arises for the familiar one when there is market power -- marginal revenue, not price, measures the gain to the monopolist.³³ These incentives can lead to countercyclical margins.³⁴

4.3 TIMING AND INTERTEMPORAL BEHAVIOR

The last example indicated how uncertainty can influence the timing of economic activity. Because intertemporal substitution is at the heart of business cycles, it is natural that understanding how uncertainty affects when people do things should be at the heart of business cycle research.

Substitution across time is analytically identical to substitution across commodities. What links prices intertemporally are interest rates at which consumers can borrow and lend. One fruitful line of business cycle research is studying the malfunction of credit markets and the effect of that malfunction on creating less intertemporal substitution than would otherwise occur, accentuating business cycles. (See e.g., Bernanke [1983].) Another line, and the one I will pursue here briefly, has to do with how uncertainty affects timing. Research on timing, exemplified by Dixit and Pindyk (1994), explains why what normally should matter in explain-

33 This point is related to Akerlof and Yellen (1985), Blanchard and Kiyotaki (1987), and Mankiw (1985).

34 Even if there is no market power, dynamic optimization complicates the analysis. For example, in a model with adjustment cost, or a model with learning by doing, output today, q , affects costs above and beyond that measured by the partial derivative of cost today with respect to q . This is well known, but it creates serious measurement problems. If an act today will increase cost tomorrow, GNP accounting is unlikely to pick it up today. This tends to cause one to underestimate marginal cost in booms.

ing behavior -- namely price which, in an intertemporal context, involves the interest rate -- seems so impotent to describe investment or inventory behavior.³⁵ I will focus on one element of timing, the resolution of uncertainty, which seems to have great potential, especially in conjunction with the analysis of durable goods, to explain business cycles.

The theory of uncertainty (e.g., Raiffa [1968]) explains why it may pay to wait, rather than plunge ahead, even if the expected discounted present value of an investment is currently positive. The reason is that by waiting, one may learn information that would cause one to decide not to invest. By waiting, one can reduce or cut off the possibility of very bad outcomes. This means that, even if a project is desirable today, the investor will tend to wait, the more likely new information will arise to resolve future uncertainty. For example, suppose that the expected discounted present value of a project if done today is \$100. There are two future equally likely outcomes -- a big success (\$1,200) or a big failure (-\$1,000). Suppose that tomorrow, the investor will learn for certain whether the project will be a huge success or a failure. Then, even though the project is profitable to do today, it may pay for the investor to delay his investment to avoid the bad outcome and to invest tomorrow only if he learns that the project will be a success.

An uncertain environment can stop or slow down the economy as investors decide to wait to resolve their uncertainty. The decline in investment activity, reinforced by a cutback in durables, can lead to a recession. But, as an economy stays in a recession, two effects occur. First, without investment, the stock of durables declines, causing an expected upsurge in future demand, and thus the expected profitability of investment to increase. Second, the longer the economy is in a recession, the probability rises that the economy will escape it

35 See Dixit and Pindyk (1994, p. 424) for a discussion of empirical attempts to explain investment timing. See also the recent successful attempt of Ghosal and Loungani (forthcoming).

(because of the first effect). The combination of these two effects is ultimately to reduce the variance of future outcomes and the value of waiting. This causes investment to occur. Roughly speaking, if there are only two states of the world -- boom and bust -- then, as the probability of escaping the bust rises toward 1 with time, the variability of outcomes will diminish and the option value of waiting declines. (That is, if Y_1 and Y_0 are income in the boom and bust respectively, then the variance of income is $P [1-P] [Y_1 - Y_0]^2$ where P is the probability that the boom will occur next period. Initially, P is low as the economy goes into recession, but P rises towards 1 as the economy uses up its durable stocks of goods, causing the variance to decline.) Therefore investment will increase, reinforced by an increase for durables, and the recession will end. Thus, the combination of the intertemporal substitution possibilities of durable goods and the option value from delaying investment work hand in hand to reinforce cyclical behavior.

CONCLUSION

Models of monopolistic competition have sharpened our understanding of certain forces shaping macroeconomic activity. However, I am skeptical that these models will lead to fundamental new insights into macroeconomics. Public finance model with taxes yield the same insights and taxes are probably a more significant quantitative explanation for the gap between price and marginal cost. For growth theory, the determinants of intellectual property rights is related to market power and, I would suspect, of more important policy and quantitative significance. Departures from perfect competition that focus on imperfections in market clearing -- real resources are used to clear markets -- and the mechanisms of intertemporal substitution (especially under uncertainty) are areas in which research is likely to have large payoffs.

Since this is a conference on macroeconomic models, I will close by addressing what empirical recommendations, if any, flow from my analyses. Models where delivery lags appear in demand curves, where the price variance influences demand, and where the variance of key underlying information influences timing of investment strike me as fruitful. Models using market share to measure market power, with the possible exception of some durables, should not be a high priority.

APPENDIX 1

OLS REGRESSIONS FOR FIGURES (T-RATIOS IN PARENTHESIS)

Fig. 3:

$$\begin{array}{l} \text{Per Capita GDP vs. Capital-Labor Ratio (1990)} \\ 90\text{gdp} = 1520 + 0.304 \text{ K/L90} \quad 58 \text{ observations} \\ \quad (3.03) \quad (15.21) \quad R^2 = .80 \end{array}$$

Fig. 4:

$$\begin{array}{l} \text{Per Capita GDP vs. Intellectual Property Rights (1990)}^{36} \\ 90\text{gdp} = -1955 + 3047 \text{ IP 90} \quad 106 \text{ observations} \\ \quad (-1.99) \quad (7.73) \quad R^2 = .37 \end{array}$$

Fig. 5:

$$\begin{array}{l} \text{Intellectual Property Rights vs. Capital-Labor Ratio (1990)} \\ \text{IP90} = 1.94 + 0.000037 \text{ K/L90} \quad 58 \text{ observations} \\ \quad (11.90) \quad (5.64) \quad R^2 = .36 \end{array}$$

36 1990 Intellectual Property Protection: Park (1995a)

Each country's score is based on the following features of its patent protection: 1) availability of patent protection in various industries; 2) membership in international intellectual property agreements such as the Paris Convention (1883) and the Patent Cooperation Treaty (1970); 3) loss of protection through working requirements, compulsory licensing and conditions for revocation of patents; 4) availability of specific mechanisms for enforcement of patent protection; and 5) the duration of patent coverage in years.

A score of 0-1 is granted for each component based on the percent of "important conditions or features" that are met for that component.

The unweighted scores are summed to give the country's level of Intellectual Property Protection.

0: no patent protection
5: maximum patent protection

Fig. 6:

Capital-Labor Ratio vs. Human Capital Per Capita (1990)

$$K/L90 = -2054 + 2936 \text{ HC} \quad \begin{array}{l} 58 \text{ observations} \\ R^2 = .29 \end{array}$$

(-0.43) (4.73)

Fig. 7:

Per Capita GDP Growth vs. Intellectual Property Rights (1960-90)

$$(\text{annual per capita GDP growth})_{1960-90} = 0.00539 + 0.00592 (\text{average IPR})_{1960-90}$$

(1.16) (2.93)

106 observations

$R^2 = .08$

Avg per capita GDP Growth Rate (1960-90): Summers and Heston (1991)

•Avg GDP Growth Rate (1960-90) = $[\text{GDP}_{90}/\text{GDP}_{60}]^{1/30} - 1$

• $\text{IPR}_{1960-90} = (\text{IPR}_{60} + \text{IPR}_{65} + \text{IPR}_{70} + \text{IPR}_{75} + \text{IPR}_{80} + \text{IPR}_{85} + \text{IPR}_{90})/7$

Fig. 8:

Intellectual Property Rights vs. Per Capita Higher Education R&D Expenditures³⁷

$$\text{IP90} = 2.18 + 0.0562 \text{ High/pop} \quad \begin{array}{l} 57 \text{ observations} \\ R^2 = .37 \end{array}$$

(17.27) (5.64)

37 If one uses IP for the year 1980, instead of 1990, one obtains similar results.

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