

Sectoral Shocks and Policy Responses in a Monetary Search Model

Dror Goldberg

Texas A&M University

07/24/05

Abstract

In a monetary search model, a temporary, large, and negative sectoral shock generates a long, economy-wide business cycle. The shock is propagated across sectors and through time by consecutively affecting the purchasing power of different types of agents. The economy stabilizes automatically, but the recovery from a recession can be improved by various monetary and fiscal policies. The model is qualitatively consistent with some basic business cycle facts, such as persistence, sectoral comovement, immediate amplification, and a hump-shaped response of output.

JEL: E32, E63.

* dror@econmail.tamu.edu. I thank seminar participants at Texas A&M, the 2004 Wegmans Conference, 2005 Midwest Macroeconomics Meetings, 2005 Conference of the Society for the Advancement of Economic Theory, Per Krusell, Adalbert Mayer, George Selgin, Ross Starr, and Genevieve Verdier, for comments and suggestions.

The paper is available at <http://econweb.tamu.edu/dgoldberg/research/sectoral.pdf>

“What calls for explanation is, in the first place, the duration and wide amplitude of the fluctuations—particularly those in the negative direction, since the upward movement, the approach to full employment, might be explained as a natural consequence of the inherent tendency of the economic system towards equilibrium.”

Gottfried Haberler (1963, p. 265)

The terrorist attacks of September 11, 2001 caused, among other things, an unusually large shock to a specific sector, whose service – commercial flights – was proven to be unsafe. Policy-makers feared a collapse in consumer spending. Those who looked to economists for an advice found recommendations based on an analysis of aggregate shocks (lower interest rate and lower taxes), and on Keynesian intuition (“go shopping or the terrorists will win”). Some economists argue that the government should not even try to prevent recessions. The government’s eventual economic response was varied. Some pre-existing mechanisms, such as unemployment insurance, automatically helped mitigate the effects on the many newly unemployed (mainly in the airline industry). Some discretionary mechanisms were put into effect: The Fed lowered the interest rate; FEMA aided New York City; the President declared New York City a disaster area, thereby giving it more fiscal benefits. Congress gave ad-hoc support to New York State and the airlines. Eventually, in spite of the uncertainty, the slow improvement in airline security, and sharp declines in employment and the stock market, the growth in consumer spending was almost unchanged (Figure 1). Businesses and government officials alike were surprised by this fortunate outcome¹.

These events raise many questions for economists. Were all of these measures necessary for maintaining the stability of consumer spending? How significant were the low oil prices and tax cuts that had just become effective, and the private savings of fired workers? Would the results

¹ Board of Governors of the Federal Reserve System (2002).

have differed had the shock hit the economy during an expansion rather than during a slump? Many of the questions cannot be fully answered in models of aggregate shocks.

This paper suggests a basic framework to address the issue of a large negative shock to a specific sector, and could form a basis for answering these questions. Such a shock can generate an aggregate business cycle through its effect on consumer spending. The chief novelty here is an analysis of policies that can curtail a recession. To this end, I use a family of models, which are based on the model of Kiyotaki and Wright (1989). Since that model is *supposedly* too narrow for analyzing broad macroeconomic issues, it is useful to explain the intuition up front.

In a typical monetary search model, there are n types of perishable goods and agents, where agents specialize in production and consumption in the following way: Type i produces good i and consumes good $i+1 \pmod n$. Due to the absence of memory and contract enforcement, agents can obtain goods only through the use of fiat money. If the production of good i is made temporarily impossible for some exogenous reason, or the demand for that good temporarily disappears, the income of type i agents is reduced. Since they have less money after the shock hits, these agents will buy less of their consumption good, good $i+1$, next period. Their low demand for good $i+1$ will, in turn, reduce the money holdings of that good's producers – type $i+1$ agents – so that these agents will later buy less of good $i+2$, and so on. The propagation of the shock continues in a chain reaction from one sector to another, like a domino effect, even if the shock to good i lasts only one period. I explain below how the economy automatically returns to steady state after n periods.

The conditions needed to make this mechanism work turn out to be the same conditions that make it essential to use money as a medium of exchange. The frictions in such an economy imply that various policies can help, and the simple structure of the model allows easy analysis

of such policies. Both monetary and fiscal policies can help by providing money to the hit agents, thereby preventing the propagation of the shock to other sectors. The outcomes of these policies critically depend upon the timing, the quantity of money transferred, the tax scheme (if needed), and – most importantly – the exact distribution scheme.

The results of the models presented here are applicable to a wide range of circumstances. These include both a drop in demand for an unsafe service or product (e.g., the demand for beef in the wake of mad cow disease), and a sudden lack of raw materials (e.g., a crop-damaging drought). In both cases, the producers' income is low, and – absent sufficient private or public forms of credit, savings, or insurance – their purchasing power drops, thereby reducing the demand for *other* goods in the following periods. This propagation mechanism is relevant even for “aggregate” shocks, such as oil shocks and financial crises. Although such shocks affect many people directly, they do not affect everyone in the same way and at the same time².

All of the above cases exemplify shocks that are negative, easily observable, and potentially blamable for recessions in public opinion. Indeed, in business cycle frequencies, bad shocks seem to be more important than good shocks. It is hard to imagine a positive shock to demand for commercial flights that can have the absolute magnitude of 9/11. Recessions, therefore, are attributed in public opinion to negative shocks more often than expansions are attributed to positive shocks. Many agree with Haberler's conjecture (quoted above), that the business cycle is caused by a negative shock, which is followed by a natural recovery. Therefore, I focus on negative shocks, of the sort we read about in newspapers³. There is common knowledge about

² E.g., a journalist who invests only in T-bills is initially relatively unaffected by an oil shock or a financial crisis. Later on, he may be fired because the people directly affected by these shocks reduce their newspaper purchases.

³ Mankiw (1989) criticizes RBC theory for attributing cycles to shocks that we do not observe or read about.

them, and they are prime candidates in public opinion for causing or prolonging recessions. In this paper, an expansion is synonymous with a recovery from a recession.

The propagation of changes in purchasing power from one agent to another is implicit in the static Keynesian multiplier (Keynes [1936]). In contrast, the idea here is inherently dynamic and creates a long, auto-stabilizing business cycle. The notion of insufficient demand is also a key ingredient in the disequilibria literature initiated by Clower (1965) and Leijonhufvud (1968). That literature analyzes the non-clearing of markets in a Walrasian framework, whereas here I use a non-Walrasian model. Cooper and Haltiwanger (1990) show this consumption spillover in a non-monetary model, with the shock propagating across sectors immediately due to the lack of, and need for, money. Persistence in that model crucially depends on inventories. In contrast, here there are no inventories; lags between receiving a monetary income and spending it create propagation across sectors and through time. Other consumption spillovers in the literature (Jevons [1909], Murphy, Shleifer, and Vishni [1989]) emphasize the decisions of agents who work in *other* sectors and consume the shocked good, while here the mechanism is based on the impoverishment of the agents who work in the shocked sector.

Long and Plosser (1983) link sectors by assuming that all goods are used as intermediate inputs in the production of all other goods. However, if there are many sectors, all subject to i.i.d. productivity shocks, then any negative shock in one sector will be offset by a positive shock in another sector (due to a law of large numbers). Horvath (1998, 2000) shows that sectoral shocks do create aggregate fluctuations if special assumptions are made regarding the interaction between intermediate goods and final goods (see Dupor [1999] for a dissenting view). Scheinkman and Woodford (1994) reach a similar conclusion in a different model with demand shocks. In contrast, this paper assumes no intermediate goods, and shocks of opposite signs can

still result in a recession. Long and Plosser (1983), and the models based thereon, do not analyze policies, as business cycles are optimal in that framework, while here I analyze policies.

The paper is organized as follows. The basic model and the steady state are presented in Section 1. In Section 2, I illustrate how the simplest possible shock realization results in a long recession and automatic stabilization. In Section 3, I show that all essential elements of a monetary search model are needed to make this mechanism work. Monetary policies are in Section 4, and fiscal policies in Section 5. The rest of the paper is essentially about robustness. More complicated shock realizations (Section 6) and minor modeling changes (Section 7) show that the model can easily generate other business cycle regularities (e.g., a hump-shaped response, immediate amplification, and sectoral comovement) without diminishing the basic propagation mechanism and the persistence. Section 8 shows that the propagation mechanism is robust to changes in the rigid preferences of the Kiyotaki-Wright model. Section 9 concludes.

1. The Basic Model

In order to show the workings of the model as clearly as possible, it is useful to keep the original indivisibilities of the Kiyotaki-Wright model.

1.1. Environment

This is a discrete-time, infinite-horizon economy. There are n types of indivisible produced goods, households, and raw materials. Goods and households are denoted $i = 1, \dots, n$; raw materials are denoted $r(i) = r(1), \dots, r(n)$. There is a continuum of infinitely-lived households with a fixed unit mass, with equal proportions of each type. Each household consists of two agents: A buyer and a seller. Households specialize in both consumption and production: Type i produces only good i and consumes only good $i+1$. Households derive utility u from consumption of one unit of their desired good, and disutility c from producing one unit of their

production good. This cost, c , is arbitrarily small. Thus, households produce whenever the money earned by selling the product may increase their consumption in the future, and yet it helps precluding a gift-giving equilibrium. Households cannot consume or produce more than one unit each period.

Production of one unit of a typical good i requires the following inputs: The household's land, one indivisible unit of the seller's time, $l(i) \in \{0, 1\}$, and one indivisible unit of a specific raw material, $r(i) \in \{0, 1\}$, which is given as endowment with some probability every period. The production function is fixed, and there is no fluctuating or growing productivity parameter. The amount of output that each household i produces is always $y(i) = \min[l(i), r(i)]$.

All goods and raw materials perish at the end of a period. This implies that a good is produced only if the seller is visited by a buyer that period, and commodity money is impossible. Trading histories are private information and long-term contracts across types cannot be enforced. The only durable object is indivisible intrinsically useless money. Agents can hold any amount of money. I allow households to pool money and redistribute it in a lottery in order to overcome indivisibility problems. Buyers make take-it-or-leave-it offers⁴.

Because the key to propagation is a distortion in the distribution of money, it is useful, for expositional purposes, to have a degenerate distribution in the steady state. In order to achieve this I replace the standard, random-matching assumption, with the partially-directed search assumption of Goldberg (2003). All households of type i live in City i , which is the only place where good i can be produced. Each household i owns one non-tradable piece of land in City i , which is where the seller always stays. There, the seller can produce and sell a good to a buyer of another type. At the beginning of a period, a buyer can travel without cost to any particular city,

⁴ Nothing changes if instead sellers post price offers and buyers choose reservation prices (see working paper).

where he is randomly matched with no more than one seller. This randomness prevents bilateral credit. The shorter side of the market is always fully matched, and no seller is visited by more than one buyer of a given type. At the end of a period, the buyer returns home with the purchased good and/or money. I show below how this creates a degenerate steady state money distribution.

All of the above implies that a trade will be conducted between household i and household $i+1$ if and only if a type i buyer visits a type $i+1$ seller who is willing to produce the good and has the necessary raw material. The supplies of raw materials available at any period are common knowledge for everyone.

For most of the paper, unless noted otherwise, I analyze the simplest version of the model: The number of types of goods and households (n) is 3; initially every household is endowed with one unit of money (henceforth “\$1”). Aggregate money supply is normalized to $M = 3$.

1.2. Strategies and Equilibrium

Every period, a household needs to decide whether to produce. The equilibrium is a rational expectations Nash equilibrium in pure strategies. The decision of whether to go shopping is trivial, since there are no travel costs to other cities, shopping does not come at the expense of production and sales, prices cannot be expected to decline in the future (given the \$1 endowments and the indivisibilities), and utility is discounted by a factor $\beta < 1$.

It is easy to show that there is a symmetric equilibrium in the initial period where all households produce and trade for \$1. Output per household in this equilibrium is 1. With three types, aggregate output is 3. Since all buyers go shopping, everyone gets a match, and the distribution of money holdings remains degenerate at \$1 per household. Therefore, the

equilibrium can recur in the following period if there are no shocks. This is the steady state, which, by construction, has full (self-)employment.

The dynamic analysis is restricted to particular paths of equilibria. I consider only the class of equilibria that satisfy the following *long-run* neutrality properties: First, given enough time without real shocks, the economy goes back to the steady state⁵. Second, money is neutral.

2. A Business Cycle

Suppose that in period -1 the economy is in full employment, but in period 0 there is a once-and-for-all shock to the supply of the raw material $r(1)$ needed to produce good 1. The shock is exogenous, unexpected, and negative. The shock is *total*, meaning that no units of good 1 can be produced in this period. This simplifies the analysis considerably, because it avoids the distraction of explicitly analyzing price changes or rationing in Sector 1. These price changes are not critical because the only thing that matters here, qualitatively, is that the income of *some* households drops. A total supply shock is observationally equivalent to a total demand shock, where all type 3 households do not want to buy good 1 during period 0.⁶

Due to discounting, type 1 buyers still go shopping in period 0, thereby ending the period with no money. Since type 3 households cannot consume in period 0, producing that period leaves them with \$2. It is optimal for them to do so because they know they will need the extra money when the propagated shock hits them in the near future.

⁵ Leijonhufvud's (1968) notion that a shock can result in a permanent deviation from steady state unless the government intervenes is not allowed here, even though it could be analyzed in this framework.

⁶ The difference between the two types of shocks is sometimes arbitrary. In the case of chicken flu the producers chose to destroy the animals, while in the case of mad cow they did not, leaving it to consumers (mainly foreign governments) to reduce demand.

Table 1 summarizes the events and states during every period. The numbers in the “Sell” and “Buy” columns denote quantities of goods sold or bought by the average household that period, while “End m ” refers to the quantity of money held by the average household at the end of that period. The bold “0” indicates the exogenous shock, and “ Y ” is aggregate output.

Table 1: The Basic Model

Period	Type 1			Type 2			Type 3			Y
	Sell	Buy	End m	Sell	Buy	End m	Sell	Buy	End m	
-1	1	1	1	1	1	1	1	1	1	3
0	0	1	0	1	1	1	1	0	2	2
1	1	0	1	0	1	0	1	1	2	2
2	1	1	1	1	0	1	0	1	1	2
3	1	1	1	1	1	1	1	1	1	3

In period 1, the production of good 1 can be restored. Type 1 households must resume production in order to consume ever again – and the sooner the better. Therefore, they produce and sell to type 3 households. With buyers having all the bargaining power, but trade limited to one unit, the buyers pay the minimal amount of money. With a price level of 1, this means that type 3 buyers pay type 1 sellers only \$1, even though they have \$2.

The money that type 1 sellers earn in period 1 arrives too late to be used for shopping in period 1. Type 1 buyers therefore cannot buy good 2. Type 2 households, then, do not produce, and they still buy from type 3, so now type 2 households are the ones who end the period without money. Type 3 households buy and sell for \$1, so their money holdings are unchanged.

In period 2, type 2 households have no money, so they cannot buy from type 3. Type 3 households buy from type 1, so they end up with a net loss of \$1 in that period. Since they accumulated \$2 earlier, they are now back down to \$1, just like all other households. Note that the distribution of money holdings at the end of period 2 is exactly as in the steady state. Given that, and with no new shocks, in period 3 we are back at full employment.

This is the basic mechanism that the paper suggests. The trigger for the recession can be a supply shock or a demand shock that directly affects only one sector and for only one period. It impoverishes the households making a living in that sector⁷, and this brings down all other sectors, one by one, like domino blocks. While in the static Keynesian multiplier all the domino blocks fall simultaneously (thus creating a large multiplier), here each sector falls in a different period. As Haberler (1963, pp. 231-2) notes, this lag must exist in a monetary economy. A period here corresponds to the frequency of receiving a paycheck or a dividend (a week to a quarter).

The model shows explicitly how the economy automatically stabilizes and goes back to steady state. After the sectors start failing, they also recover, one by one. The sector that was hit first recovers and accumulates money. Next period, this new purchasing power will help in the recovery of the next sector, and so on. It turns out that there are two processes of a dynamic Keynesian multiplier: One of them propagates the reduction in output, causing contagion across sectors; as soon as the original exogenous shock is gone, the other process revives the production in every sector, in the same order, with a lag.

Table 1 shows persistence but does not show other business cycle regularities, such as sectoral comovement, immediate amplification of the shock, or a hump-shaped response of output. This problem is easily solved when more complicated shock realizations and minor modeling changes are incorporated (Sections 6 and 7, respectively). In Section 8, I show that the mechanism is robust to changes in the extreme Kiyotaki-Wright preferences.

Clearly, if the number of sectors is very large, then the reduction in aggregate output of $1/n$ of its steady state value is negligible. This means that the model is relevant only for a level of

⁷ This should be interpreted as workers, shareholders, and possibly creditors and insurance companies who make business with this sector, if they are not diversified enough.

disaggregation of, say, the U.S. two-digit Standard Industrial Code. A shock to the production of any slightly differentiated product, say bluefish⁸, cannot trigger a business cycle, either in this model or in reality. However, a large shock to the entire fishing industry due to, for instance, a huge oil spill, *can* trigger a business cycle. Again, this paper deals only with the sort of shocks that are important enough to be read about in the newspapers.

3. Necessary and Sufficient Conditions

The essential ingredients of a monetary search model are specialization in production, specialization in consumption, more than two types of goods and agents, inability to enforce contracts, and private information regarding trading histories. The sufficiency of these ingredients, taken as a group, in generating a persistent response to a temporary shock is shown in Section 2. Here, I show that if these ingredients are taken out, *one at a time*, and nothing else is added to the model, the shock does not propagate.

3.1. Taking Out Specialization in Production

If households can produce any good, they might stay in autarky, where, obviously, there is no propagation. To give propagation (and trade) a chance, households must be unable to produce as much of their consumption good as they want to consume. Consider, then, these alternative assumptions: Every household of any type can produce one unit of any type of good every period; normally every household gets one unit of each raw material every period; every type i household wants to consume three units of good $i+1$ every period.

In steady state, there is no use for money, as all trade can be conducted through direct barter. For example, a type 1 household can do the following: Consume its unit of good 2; barter its good 1 for a unit of good 2 that is produced by type 3; and barter its good 3 for a unit of good 2

⁸ This is the first category in SIC group 0912 Finfish (http://www.osha.gov/pls/imis/sic_manual.html).

that is produced by type 2. The other trades are shown in Figure 2. Aggregate steady state output is 9. I assume that there are no matching frictions in the direct barter⁹.

A total shock to Sector 1 reduces output in other sectors too, since two out of three barter opportunities – those that involve good 1 – no longer exist. The result is a drop in aggregate output from 9 to 4. The shock is amplified, but there is no persistence: Next period, if there are no new shocks, everything returns to normal, because all the barter opportunities reappear¹⁰.

3.2. Taking Out Specialization in Consumption

Assume instead that every household enjoys consumption of one unit of every good in every period, and that a household of type i can produce three units of good i per period. A type 1 household produces three units of good 1, consumes one of them, and barter the others (Figure 3). The result of a shock to Sector 1 is the same as above: Most barter opportunities disappear, aggregate output falls from 9 to 4, but full recovery is possible in the following period.

3.3. Taking Out the Assumption that $n > 2$

Assume that there are only two goods, and households do specialize: Type i produces good i and consumes the other good. In steady state, barter can work perfectly¹¹. With a shock to Sector 1, type 2 has no incentive to produce or travel, so aggregate output is 0. If there are no new shocks, barter resumes in the following period so aggregate output is back at 2.

⁹ There is an equilibrium where each type i buyer takes his produced $i+2$ good to City $i+1$.

¹⁰ Although money is not needed in steady state, it can help in stabilization: Unemployed households can use it to pay for goods. That money is useful for its recipients because it can be used after future shocks, but until then barter is resumed and the money is idle. Thus, even such a change in the money distribution does not propagate shocks. Detailed analysis of the case where households can, or must, use money, is in the working paper.

¹¹ There is an equilibrium where in odd periods type 1 travels to City 2 and in even periods type 2 travels to City 1.

3.4. Taking Out the Inability to Enforce Contracts

If households of all types can enter a contract, they can all agree that whenever a seller can produce a good, he will produce it and give it for free to any visiting buyer. Money is not needed. With a one-period shock to Sector 1, everyone understands that type 1 is not at fault for not giving good 1 this period (recall there is common knowledge about shocks). Therefore, this is not a violation of the contract. Next period, type 2 will then still agree to give good 2 to type 1. The shock, therefore, is not propagated.

3.5. Taking Out Private Information on Trading Histories

If trading histories are publicly known there can be a gift-giving equilibrium, where goods are given for free, as long as no one has deviated from that pattern. Again, money is not needed. Deviations from gift-giving behavior are excused if they result from a (known) sectoral shock, so such shocks do not propagate.

3.6. Discussion

The Kiyotaki-Wright assumptions are not common in business cycle research, but they have been partially invoked by the non-monetary literature cited in the Introduction¹². It turns out that all five essential ingredients of the Kiyotaki-Wright model are needed to make this propagation work, if no other ingredients are added. There is an inherent and close relation between the essentiality of money and this propagation of shocks in a monetary economy.

Existing sectoral shock theories of business cycles make other unusual assumptions, most of which have not been validated empirically. Horvath (2000) proves that his assumptions

¹² Cooper and Haltiwanger (1990) have double specialization and no credit; Murphy, Shleifer, and Vishni (1989) have specialization in production and no credit; Scheinkman and Woodford's (1994) propagation depends on *local connectivity* between intermediate goods and final goods, which is analogous to the Kiyotaki-Wright specializations.

regarding the interaction between intermediate goods and final goods hold for the postwar U.S., but it is not known whether they hold for other countries and other time periods. In contrast, this section shows that the essential assumptions of the current paper are trivially verified for many countries and many time periods: Any society that has found it essential to use money as a medium of exchange has this propagation mechanism inherent in its economic system¹³.

4. Monetary Policies

The socially optimal solution to the shock's propagation is for type 3 households to give their money to type 1 households in period 0, even though they do not get goods in return. Without credit markets, they have no incentive to do so. Without private insurance or savings, only the government can help the economy. *Monetary policy* is defined here as a policy that adds new money and does not tax anyone. Such a policy can be helpful in that it gives money to the “weakest link” – the households who become impoverished by the shock. In doing this, it helps maintaining stable demand for the other goods. The exact way in which the money is added turns out to be important. I assume that prices are flexible, the policy is unexpected, and inflation has no costs. Analysis under alternative assumptions is in the working paper.

4.1. A Lump-sum Transfer

Suppose that, right after the shock, at the end of period 0, the government unexpectedly gives \$1 to each household of any type.

Lemma 1: There is an equilibrium where the price level increases to 2 in period 1.

¹³ This is consistent with Mitchell's (1927) claim that business cycles, in their modern form, began only when autarky gave way to reliance on money incomes generated from specialization in the production of a few goods, with these incomes then used to buy other goods (pp. 75-82). However, he lumps this development with the development of credit markets.

Proofs are in the Appendix.

In Table 2, in the “End m ” column, “ $j; k$ ” means that at the end of trade the household had $\$j$ and after policy intervention it has $\$k$, and “ P ” is the current price level. Quantities are averages per household: Type 1 households cannot use their $\$1$ given the new price level and indivisibility of goods. They pool this spare $\$1$ within their type and redistribute it in a lottery: Half get nothing and half get $\$2$ each. Then in period 1, half of them buy and half of them do not. The same goes for type 3 households. They redistribute their money such that half of them have $\$2$ each and half have $\$4$ each. Those losing in the lottery get the privilege of producing in period 2 when demand is low.

The policy is helpful because it immediately restores some of type 1’s purchasing power, thus reducing the magnitude of the propagated shock.

Table 2: A Lump-sum Transfer

Period	Type 1			Type 2			Type 3			Y	P
	Sell	Buy	End m	Sell	Buy	End m	Sell	Buy	End m		
-1	1	1	1	1	1	1	1	1	1	3	1
0	0	1	0; 1	1	1	1; 2	1	0	2; 3	2	1
1	1	.5	2	.5	1	1	1	1	3	2.5	2
2	1	1	2	1	.5	2	.5	1	2	2.5	2
3	1	1	2	1	1	2	1	1	2	3	2

A $\$2$ lump-sum transfer seems even better: With a new money supply $M = 9$, the new price level is 3, and type 1 can buy $2/3$ units in period 1. Output is then 2.67 until the return to full employment. As seen in the tables above, the economy is back at full employment if and only if the previous period ends with a degenerate money distribution. Given that the sectoral shock distorts the distribution, a lump-sum transfer can realign it immediately only if it is infinitely large. With inflation costs this is clearly not optimal (and makes money valueless), but it hints that a fast recovery may be achieved if the policy is more directed towards the hit sector.

4.2. A Directed Transfer

A monetary transfer directed only at type 1 may be a better approximation to open market operations than the above policy. This is because, when one sector is hit and its workers and owners lose wages and dividends, they are more likely than others to sell bonds for cash (Alvarez, Atkeson, and Kehoe [2002]). The injection of new money, traded for bonds immediately after the shock, is then more likely to happen with agents in the hit sector.

Suppose then that the government gives new money to those hit directly by the initial shock, and that, as before, the money supply jumps by 100%. The results are in Table 3.

Table 3: A Directed Transfer

Period	Type 1			Type 2			Type 3			Y	P
	Sell	Buy	End m	Sell	Buy	End m	Sell	Buy	End m		
-1	1	1	1	1	1	1	1	1	1	3	1
0	0	1	0; 3	1	1	1	1	0	2	2	1
1	1	1	3	1	.5	2	.5	1	1	2.5	2
2	.5	1	2	1	1	2	1	.5	2	2.5	2
3	1	1	2	1	1	2	1	1	2	3	2

The aggregate results happen to be identical to those of a 100% lump-sum transfer, but in general this is not the case. To find the optimal size of the transfer, the policy-maker needs to take into account that resurrecting type 1's purchasing power with too much money decreases the purchasing power of others (through the increase in prices). In particular, type 1's purchasing power should not be made more than it can consume (1 unit). Ignoring easily avoidable divisibility issues¹⁴ and inflation costs, the best policy is described in Lemma 2 and Table 4.

Lemma 2: The best directed transfer (and the new price level) is 1.5.

¹⁴ Indivisibility is not an issue if steady state money holdings are already even, say because of a previous monetary expansion. If everyone already has \$2, Lemma 2 means that the transfer and the new price level are both \$3.

Table 4: The Best Directed Transfer

Period	Type 1			Type 2			Type 3			Y	P
	Sell	Buy	End m	Sell	Buy	End m	Sell	Buy	End m		
-1	1	1	1	1	1	1	1	1	1	3	1
0	0	1	0; 1.5	1	1	1	1	0	2	2	1
1	1	1	1.5	1	2/3	1.5	2/3	1	1.5	2.67	1.5
2	1	1	1.5	1	1	1.5	1	1	1.5	3	1.5

4.3. Discussion

The closer the policy brings the distribution of money holdings back to a degenerate one the quicker is the return to steady state. Since the steady state has full employment, the quicker is the return the better. Therefore, a proportional transfer (not shown above) is completely useless, while the optimal monetary transfer (not shown above) would give \$2 to type 1 and \$1 to type 2, thus immediately realigning the money distribution and restoring the steady state¹⁵.

5. Fiscal Policy

Fiscal policy is defined as a policy that does not add new money, but taxes and then redistributes existing money. The redistribution can be a gift, or a wage for the production of public works, whose utility is not modeled. Such a policy is another way of providing badly needed money to the “weakest link,” only that this time it comes from other taxpayers rather than the central bank. I ignore the possibility that this money is already at the Treasury or borrowed by it.

5.1. An Example

Suppose that at the end of every period the government randomly takes \$1 from a fraction $X < 1$ of those households who have more than they need for current consumption, and gives all of that money to households in shocked sectors. In steady state there are no such rich or shocked

¹⁵ A degenerate distribution in steady state is reasonable: Type i households represent everyone who makes a living from sector i , from the most junior employees to the CEO and shareholders. Taken as a group, it is not clear whether any sector in the economy is significantly richer than another, especially with free entry.

households, but after a shock to Sector 1, all type 3 households are eligible for such taxation. Since the probability to be taxed is less than 1, and the production cost is arbitrarily small, type 3 households still produce in period 0. With $X = .5$, the recovery is described in Table 5 (it is assumed that in period 2, when demand for good 3 is low, those who were taxed get the privilege to sell).

Table 5: Fiscal Policy

Period	Type 1			Type 2			Type 3			Y
	Sell	Buy	End m	Sell	Buy	End m	Sell	Buy	End m	
-1	1	1	1	1	1	1	1	1	1	3
0	0	1	0; .5	1	1	1	1	0	2; 1.5	2
1	1	.5	1	.5	1	.5	1	1	1.5	2.5
2	1	1	1	1	.5	1	.5	1	1	2.5
3	1	1	1	1	1	1	1	1	1	3

If shocks are uniformly distributed across sectors, and they are truly exogenous, all types would be happy ex-ante with such a policy. Applied to reality, this policy is like fiscal aid that troubled sectors sometime receive. Notable examples include “too big to fail” policies regarding banks, and aid to the airline industry after 9/11. The sectors in this model can alternatively be interpreted as geographical areas that trade with each other (counties, states, or even countries). Thus, the model somewhat justifies federal assistance to disaster areas by FEMA and/or through a presidential declaration of *disaster areas*, which makes them eligible for fiscal benefits. Of course, in reality, issues of moral hazard make such policies problematic.

5.2. A Policy Lag

Ad hoc fiscal aid requires legislation, and this could take time. The common wisdom is that such a policy lag can be harmful: A tax cut might stimulate the economy after it had already recovered, thereby causing an excessive expansion and a crisis later on. Here, I show a different problem caused by a policy lag when a specific sector gets aid. As before, the shock is only in

period 0. Legislation is written in period 1, and the aid (financed by progressive taxation) is given to Sector 1 at the end of period 1. As seen in Table 6, the policy lag delays the return to full employment compared with non-intervention.

Table 6: Fiscal Policy with a Lag

Period	Type 1			Type 2			Type 3			Y
	Sell	Buy	End m	Sell	Buy	End m	Sell	Buy	End m	
-1	1	1	1	1	1	1	1	1	1	3
0	0	1	0	1	1	1	1	0	2	2
1	1	0	1; 1.5	0	1	0	1	1	2; 1.5	2
2	1	1	1.5	1	0	1	0	1	.5	2
3	.5	1	1	1	1	1	1	.5	1	2.5
4	1	1	1	1	1	1	1	1	1	3

The reason is that, when help arrives, Sector 1 had already recovered, and now the trouble is with Sector 2. Without government intervention (Table 1), the crisis is about to be over, because in the following period – period 2 – Sector 2 will transfer the shock to Sector 3, which is cushioned against the shock because it had previously saved money. With a policy lag, however, the shock that is about to hit (the taxed) Sector 3 is not as diminished as in Table 5, but still bears its full magnitude. One solution is to prepare an assistance package in advance, as is done in the context of geographical areas (disaster area legislation). Another solution is to assist those who are *currently* unemployed or without money – namely, unemployment insurance and food stamps. The policy described in Table 5 is observationally equivalent to these two policies.

6. Other Shock Realizations

The basic mechanism here is the propagation of a shock across sectors and through time. To show this, the above analysis dealt with the simplest case of a single one-period shock. In this section, I show that other shock patterns can generate interesting results that are consistent with important business cycle regularities.

6.1. An “Aggregate” Shock

When two sectors are hit at once (Table 7), the recession is initially worse, but it is shorter. The reason is that, because of the shock to Sector 2, type 1 households do not buy; therefore, their money holdings are never depleted to zero. Instead, type 2 is immediately out of money, and in the following period, after failing to buy from the rich type 3, the recovery is almost completed. This case can represent a single shock that affects most sectors directly, e.g., an oil shock. Even in such a case, then, the effects of the shock persist after it is gone.

Table 7: An “Aggregate” Shock

Period	Type 1			Type 2			Type 3			Y
	Sell	Buy	End m	Sell	Buy	End m	Sell	Buy	End m	
-1	1	1	1	1	1	1	1	1	1	3
0	0	0	1	0	1	0	1	0	2	1
1	1	1	1	1	0	1	0	1	1	2
2	1	1	1	1	1	1	1	1	1	3

6.2. A Persistent Shock

Suppose that the shock lasts for two periods. Naturally, it now takes one period longer to return to steady state (Table 8). More importantly, during two periods, the output gap is twice as large as the size of any shock: In no period is there a shock of size bigger than 1, yet in periods 1 and 2, the size of the output gap is 2. The shock is amplified gradually, thus creating a hump-shaped response of output, as observed in the data (Cogley and Nason [1995]). It does not take a very persistent shock to create this effect, since a period here corresponds to paycheck / dividend frequency (weekly to quarterly). Shocks that last more than a month or a quarter are not unheard of, and will create such a hump-shaped response.¹⁶

¹⁶ One peculiar outcome of the model is that if Sector 1 is gone forever (e.g., good 1 is dodo), the economy will shut down forever after three periods. This could be avoided by assuming that after z periods, either type 3 starts

Table 8: A Persistent Shock

Period	Type 1			Type 2			Type 3			Y
	Sell	Buy	End m	Sell	Buy	End m	Sell	Buy	End m	
-1	1	1	1	1	1	1	1	1	1	3
0	0	1	0	1	1	1	1	0	2	2
1	0	0	0	0	1	0	1	0	3	1
2	1	0	1	0	0	0	0	1	2	1
3	1	1	1	1	0	1	0	1	1	2
4	1	1	1	1	1	1	1	1	1	3

6.3. A Neutral Shock

Another scenario for consecutive shocks is that the second shock happens in Sector 2 rather than Sector 1. The result is in Table 9, which is *identical* to Table 1 – the case of a single shock to Sector 1 – except that the zero sales of type 2 in period 1 are exogenous here (and thus in bold).

Table 9: A Neutral Shock

Period	Type 1			Type 2			Type 3			Y
	Sell	Buy	End m	Sell	Buy	End m	Sell	Buy	End m	
-1	1	1	1	1	1	1	1	1	1	3
0	0	1	0	1	1	1	1	0	2	2
1	1	0	1	0	1	0	1	1	2	2
2	1	1	1	1	0	1	0	1	1	2
3	1	1	1	1	1	1	1	1	1	3

The second shock is neutral because it hits Sector 2 when the demand for good 2 is not there anyway. That demand is absent because of the previous shock to Sector 1. This can explain why a negative shock of a given magnitude can affect the economy in different ways depending on its timing: If it hits during an expansion, it can cause a crisis, while if it hits at rock bottom, it may change nothing (Haberler [1963], pp. 481-2). Perhaps this is one reason for why 9/11 did not drag the economy down as far as many had feared. An earlier shock to the stock market and

consuming good 2 instead (e.g., good 2 is chicken), or type 1 develops a new good that type 3 likes (e.g., ostrich becomes the new “good 1”).

technology (Sector 1) in the preceding year impoverished many people, who then reduced their demand for flights. When the airlines (Sector 2) were hit by an independent exogenous shock (9/11), it did not matter as much as it would have in 1999 because demand was already low.

6.4. Consecutive Shocks

When the initial shock is followed by a shock to Sector 3, the recovery is very quick (Table 10). This is because the same type initially accumulating more money (type 3) is hit right after that and loses this extra money. This realignment of money holdings restores the steady state.

Table 10: Consecutive Shocks

Period	Type 1			Type 2			Type 3			Y
	Sell	Buy	End m	Sell	Buy	End m	Sell	Buy	End m	
-1	1	1	1	1	1	1	1	1	1	3
0	0	1	0	1	1	1	1	0	2	2
1	1	0	1	0	0	1	0	1	1	1
2	1	1	1	1	1	1	1	1	1	3

6.5. Discussion

This section shows that simply counting the number of shocks is misleading. The simplest possible extension – adding another shock – creates an entirely new set of possible recovery paths, and results critically depend on which sector is hit in period 1. Tables 8-10 feature three distinct recovery paths. For this reason, I have not been specific about the exact probability structure of shocks. It is not even enough to know when a shock will hit a particular sector. The entire history of shocks since the last time the economy was in full employment is crucial for any analysis. Figure 4 illustrates this point for a ten-sector model, which was simulated for one hundred periods. Each sector was hit ten times, randomly spread over the hundred periods. The top line shows the upper bound on output (steady state minus the number of shocks that period). The bottom line shows actual output. Compared to the upper bound, actual output is 25% more

volatile and 18% lower on average. The gap between the lines is very volatile. Just by looking at the number of shocks in a particular period, one cannot guess the level of actual output.

7. Amplification and Comovement

In this section, I change some of the basic model's assumptions in order to show that the model can be more consistent with business cycle regularities than has been demonstrated above. I begin by making the realistic assumption that households' specialization in consumption is not as extreme as their specialization in production: Type i households produce only good i , but can consume one unit of good $i+1$ and one unit of good $i+2$. Since good $i+2$ is now demanded by both type i and type $i+1$, I also increase the labor endowment to two units, and change the production function such that one unit of raw material enables each seller to produce two units. To maintain the infeasibility of direct barter, I set $n = 5$. I endow each buyer with \$2 to maintain the initial price level at 1.

With consumption of more than one unit per period, it is natural to allow consumption-smoothing: Households prefer consuming one unit today and one unit tomorrow, rather than two units today and nothing tomorrow. In case a household does not have enough money to buy both goods in some period, I assume that the household randomizes between them.

Amplification is defined here as an immediate drop in output larger than the size of the shock. It is easily generated now. A one-period shock to sector 1 reduces aggregate output in two ways. First, Sector 1's output is gone, as usual. Second, having \$2 and anticipating no current income, a consumption-smoothing type 1 household spends only \$1 today (say, on good 2), and saves \$1 for the next period (for buying good 3). Thus, the shock immediately reduces Sector 3's sales by half. Looking at aggregate output, the shock is amplified by 50% in period 0.

Sectoral comovement is calculated as the average of all cross-sector correlation coefficients. In the basic model all correlation coefficients equal to $-1/(1+n)$. Here comovement increases for two separate reasons. First, the consumption of two different goods increases comovement because households in the shocked sector reduce consumption of both goods, thus increasing the correlation between those two sectors: After a shock to Sector 1, some type 1 buyers buy less of good 2 while others buy less of good 3. Second, consumption-smoothing increases comovement between the shocked sector and other sectors, as shown above.

Combining the two separate effects, if Sector 1 is hit today, then Sectors 1, 2, and 3 have lower output today. The correlation coefficients for the case of a one-period shock to Sector 1 range from $-.3$ to $.95$. Their average is $.37$, which is close to the data (e.g., Long and Plosser [1987]). Figure 5 shows aggregate output and Figure 6 shows sectoral outputs. Clearly, the amplification and comovement do not reduce most of the persistence. A hump-shaped response can be added by assuming that the shock lasts for two periods, as in subsection 6.2. Such a long shock increases comovement even further, and the average of the correlation coefficients is $.42$.

Since a period in this model is between a week and a quarter, on average, the model's periods are shorter than the data used to measure comovement (monthly to annual). Thus, the model may artificially exhibit a smaller comovement than the data due to temporal aggregation. Aggregating two periods into one in the above example increases the average of correlation coefficients to $.6$. Only one out of ten coefficients is now negative and its value is $-.09$.

8. Robustness

Some readers wondered whether the propagation mechanism exists only because of the rigid preference structure of the Kiyotaki-Wright model. This section deals with such concerns.

8.1. Substitution in Consumption

The basic model assumes that households cannot shift consumption from the shocked sector to another sector. If this is allowed, then one sector is up and another sector is down, and one might suspect that there is no business cycle. Such a conjecture is wrong. To show this I modify the *basic* model (i.e., without the Section 7 modifications), by assuming that type i prefers good $i+1$ but if that good is temporarily defective or unavailable then it tries to consume another good $j \neq i$ instead. After the usual shock to Sector 1, type 3 wants to buy good 2 instead of good 1. All type 1 and type 3 buyers visit City 2. They all have \$1 each, so a higher price is impossible. The result is a lottery and rationing. Half of the buyers of each type fail to buy. As Table 11 shows, the recovery starts faster than in Table 1, but takes just as long¹⁷.

Table 11: Substitution in Consumption

Period	Type 1			Type 2			Type 3			Y
	Sell	Buy	End m	Sell	Buy	End m	Sell	Buy	End m	
-1	1	1	1	1	1	1	1	1	1	3
0	0	.5	.5	1	1	1	1	.5	1.5	2
1	1	.5	1	.5	1	.5	1	1	1.5	2.5
2	1	1	1	1	.5	1	.5	1	1	2.5
3	1	1	1	1	1	1	1	1	1	3

8.2. Substitution with Offsetting Shocks

Assume that in period 1 there is also a positive raw materials shock to Sector 2, such that each type 2 seller can produce two units of good 2. With enough of good 2 to sell to both types 1 and 3, the result is a very short recession (Table 12). However, in general, with many types of households and goods, there can still be a long recession, as will be explained below.

¹⁷ Even if the price of good 2 could be raised in response to the excess demand, a recession would follow because this would still make type 1 households poor and they would consume less in period 1.

Table 12: Substitution in Consumption with Offsetting Shocks

Period	Type 1			Type 2			Type 3			Y
	Sell	Buy	End m	Sell	Buy	End m	Sell	Buy	End m	
-1	1	1	1	1	1	1	1	1	1	3
0	0	1	0	2	1	2	1	1	1	3
1	1	0	1	0	1	1	1	1	1	2
2	1	1	1	1	1	1	1	1	1	3

With a demand for good 2 by both type 1 and type 3, each type 2 household sells two units and ends the period with \$2 (whether types 2 and 3 barter or use money does not matter). In period 0, therefore, aggregate output is still 3. Shocks of opposite signs cancel each other out in period 0, but there is a recession *after* period 0. The main point of this paper is not to demonstrate what happens when the initial shock hits. Rather, this paper illustrates that households making a living in a shocked sector lose purchasing power, and, later on, other sectors that rely on their demand are negatively affected.

In period 1 there is no offsetting effect of increased demand by newly enriched households (type 2) for various reasons: Here type 2 buys only one unit in period 1 because it cannot consume more than that; with smoothing, it will *choose* not to use all its new purchasing power in period 1; and, absent a positive shock to Sector 3 in period 1, there just isn't enough of good 3 for type 2 to buy. Thus, the impoverishment of one type is *not* compensated for by the enrichment of another type. Even when shocks cancel each other out in period 0, a recession is soon to follow.

Why does the recession end early? In the basic model, type 3 becomes rich by not consuming, and the recession is over only when the low purchasing power of the shocked sector is propagated to type 3 through type 2, thereby realigning the money distribution. Here, in contrast, type 2 is the one that becomes rich. The propagation of low purchasing power to type 2 from the shocked sector takes only one period, so the recovery is faster. However, in general,

with many more types of goods and households, say $n = 100$, there can still be a *very* long business cycle. Consider the following scenario: Type 100 prefers good 1 but would otherwise consume good 50; there is a negative shock to Sector 1; and there is a positive shock to Sector 50. Hence, output will be low for 49 periods. Thus, the propagation mechanism is, in general, qualitatively robust to the lack of substitution in consumption assumed in most of the paper.

8.3. Uncorrelated Specializations

The Kiyotaki-Wright specializations are correlated: Households who produce good i consume good $i+1$. This is unrealistic: Just because both you and I are economists does not mean we consume the same goods. Assume instead, with $n = 3$, that half of type i consume good $i+2$ instead of good $i+1$.¹⁸ The recovery starts earlier but lasts longer than in Table 1 (Figure 7).

9. Concluding Remarks

The key to the propagation of a negative shock is that it necessarily makes some agents poorer than before. Their low purchasing power reduces demand for other goods, thereby causing an aggregate business cycle. The “missing” money, which cannot be loaned here, is held by other agents, who do not spend as much of that new purchasing power as the poor agents would have if they had that money. In a monetary economy the negative consumption spillover of the impoverished agents is spread over time, thus causing persistence, because agents spend their money with a lag. The model may be viewed as a micro-foundation for a dynamic, auto-stabilizing version of the Keynesian multiplier.

¹⁸ A type 1 household who consumes good 2 can take good 1 to City 2 and try to find a seller who consumes it. It will succeed only with a 50% probability, because half of type 2 consume good 3, and they will reject the perishable good 1. Then the type 1 household might not consume if it does not use money. Money, then, is still useful.

The same conditions that make it essential to use money as a medium of exchange create this propagation mechanism. These conditions also make policies potentially helpful. Thus, it is possible to state that any economy that has ever found it necessary to use money has also had this propagation mechanism inherent in it, and had the potential to benefit from government assistance. By giving money to the shocked sector, the government may prevent contagious demand shortages in other sectors. Policies seemed to be needed in the Great Depression because the collapse of banks eliminated savings and credit. Perhaps the government should encourage people to save and insure. Perhaps the government should even encourage diversification so that people who lose their jobs will enjoy income from other sources and not end up like many of Enron's employees who invested in that company. Policies may be harmful due to bad timing, so perhaps the President should have the authority to declare a *disaster sector*, similar to the geographical *disaster area*, in order to prevent policy lags. The model is also applicable to international business cycles and IMF aid to crisis countries. It may imply that the U.S. was wise to save its southern neighbor – and one of its largest buyers – from collapse in 1995.

Using a very simple model facilitates the analysis of the propagation mechanism and the policies. In the working paper I analyze many other examples of policies, with different pricing rules, exogenous price stickiness, expectations about policies, inflation costs, more or less progressive taxation, unemployment insurance, and welfare payments¹⁹. More extensions should include: Increasing divisibilities; adding capital, imperfect financial markets, and a labor market; allowing partial shocks, which will differentiate supply shocks from demand shocks and change the price in the shocked sector; and allowing a non-degenerate steady state money distribution.

¹⁹ The latter two policies are observationally equivalent to the fiscal policy example of Section 5 in this simple model, but by assuming steady state unemployment and savings, the three policies can be differentiated.

The model could also incorporate the other consumption spillovers mentioned in the Introduction, as well as the production-side spillovers of Long and Plosser (1983), and evaluate the relative importance of each spillover.

Appendix

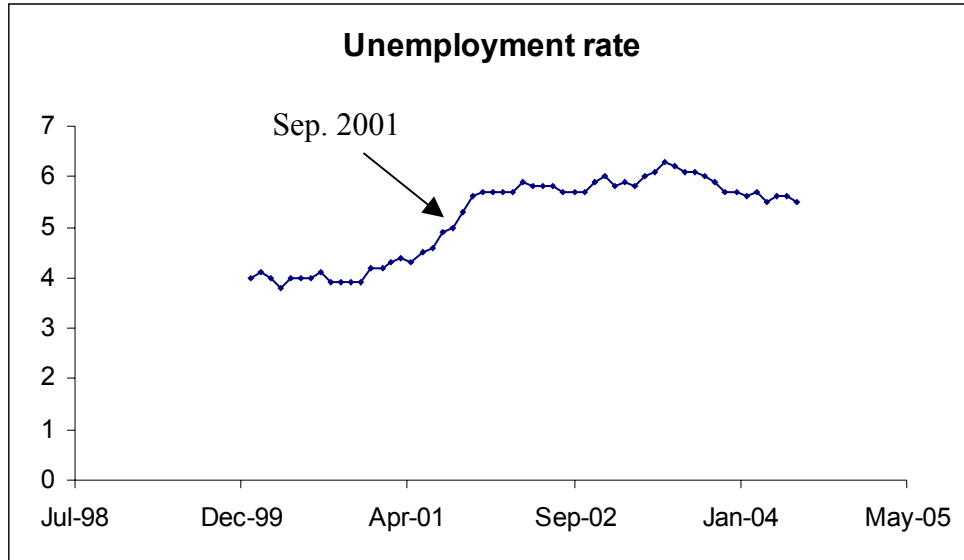
Proof of Lemma 1. Since the money supply doubles, in the long run prices must be \$2 to maintain the neutrality of money. Suppose that households expect prices to double immediately. Then households of types 1 and 3, who have an odd amount of money, cannot use one of their units of money. They pool this spare \$1 within their type and redistribute it in a lottery: Half get nothing and half get \$2 each. Then, at the end of period 1, half of type 1 households have nothing and half have \$2 each; half of type 3 households have \$2 each and half have \$4 each. A seller in period 1 who expects the prices in all other trades to increase to 2 in that period, but faces a take-it-or-leave-it offer of only \$1, will recognize that a payment of \$1 is just as good as a payment of \$0. Therefore, he will reject it²⁰.

Proof of Lemma 2. In the long-run money is neutral so all money circulates every period as in the initial steady state. That is, the velocity V is 1. A transfer of $\$T$ to type 1 then increases the long run price level to $P = MV/Y = (3+T)/3$. The transfer increases type 1's purchasing power to $T/P = 3T/(3+T)$. This exactly restores type 1's purchasing power to 1 if and only if $T = 1.5$. Then $P = 1.5$.

²⁰ The same result obtains if goods are divisible but prices are integers.

Figure 1:

(a) Seasonally adjusted Unemployment Rate since 2000



(b) Seasonally adjusted Consumption since 2000

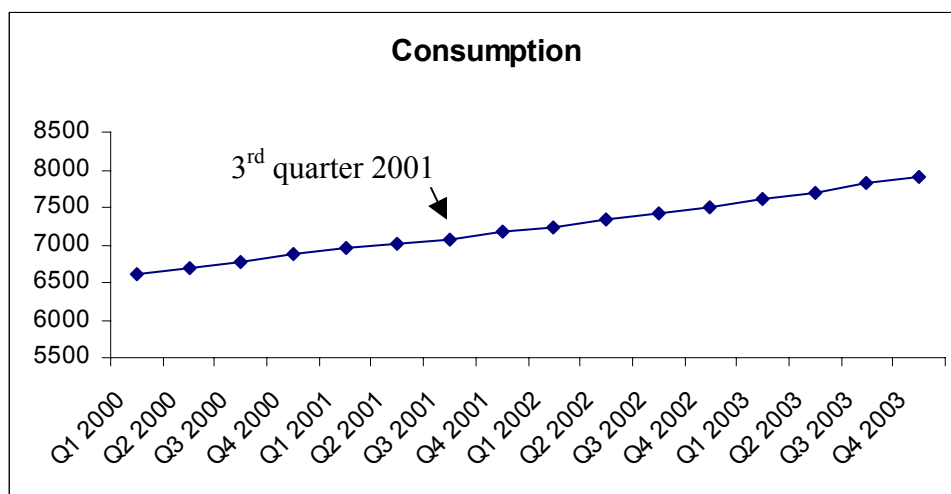


Figure 2: Agents do not specialize in Production

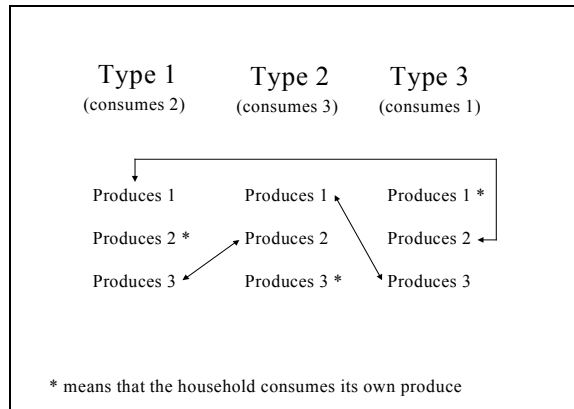


Figure 3: Agents do not specialize in Consumption

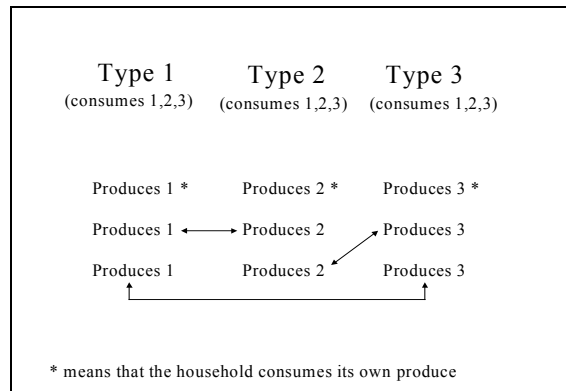
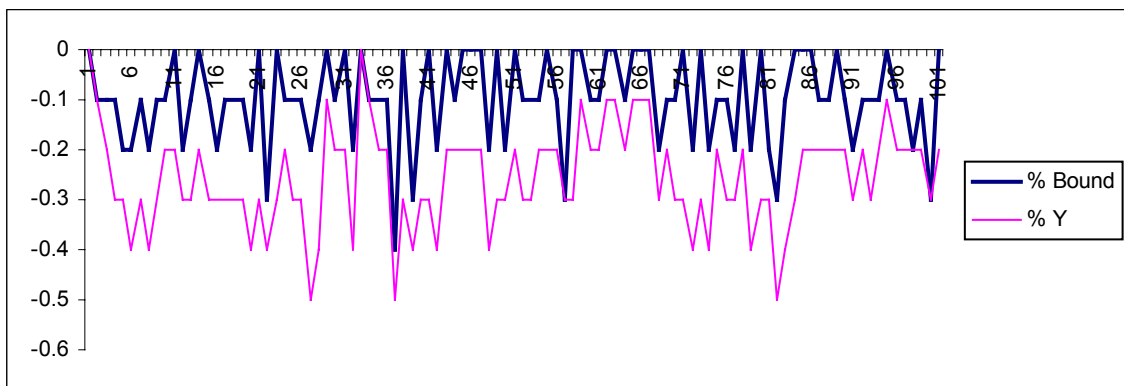
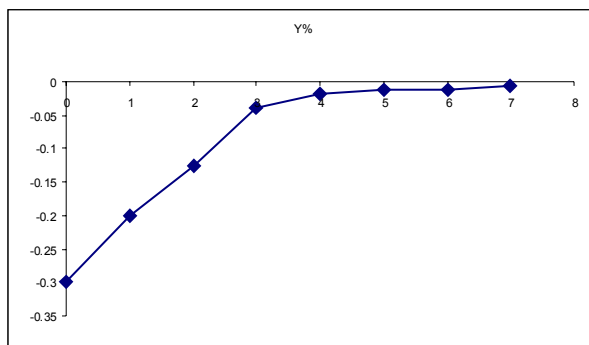


Figure 4: Potential and Actual Output (deviations from steady state) in a 10-Sector Model over 100 Periods



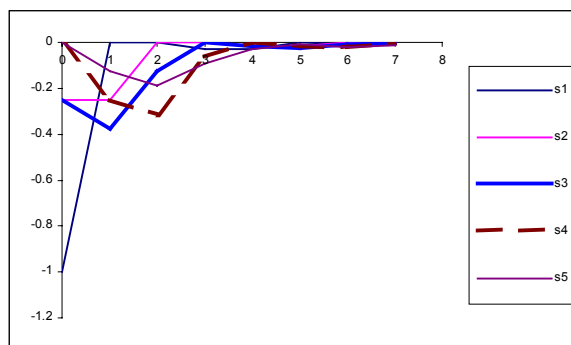
Notation: “Bound” is potential, or upper bound, on output; “Y” is actual output.

Figure 5: Aggregate Output in a Model with Amplification and Comovement



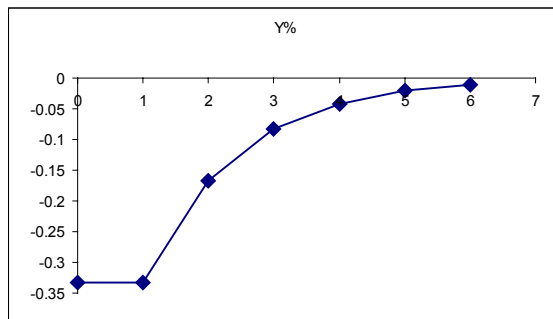
Note: The shock is of size 0.2

Figure 6: Sectoral Outputs in a Model with Amplification and Comovement



Notation: s1 is sales (and production) of good 1.

Figure 7: Aggregate Output when Specializations are Uncorrelated



References

Alvarez, Fernando, Andrew Atkeson, and Patrick J. Kehoe. "Money, Interest Rates, and Exchange Rates with Endogenously Segmented Markets." *Journal of Political Economy*, 2002, 110, pp. 73-112.

Board of Governors of the Federal Reserve System. *88th Annual Report 2001*. Washington, DC: Board of Governors of the Federal Reserve System, 2002.

Available at www.federalreserve.gov/boarddocs/rptcongress/annual01/ar01.pdf

Clower, Robert. "The Keynesian Counter-Revolution: A Theoretical Appraisal," in Frank H. Hahn and F.P.R. Brechling, eds., *The Theory of Interest Rates*. London: Macmillan, 1965.

Cogley, Timothy, and James M. Nason. "Output Dynamics in Real-Business-Cycle Models." *American Economic Review*, 1995, 85, pp. 492-511.

Cooper, Russell, and John Haltiwanger. "Inventories and the Propagation of Sectoral Shocks." *American Economic Review*, 1990, 80, pp. 170-90.

Dupor, Bill. "Aggregation and Irrelevance in Multi-Sector Models." *Journal of Monetary Economics*, 1999, 43, pp. 391-409.

Goldberg, Dror. "Money with Partially Directed Search." Working paper, Texas A&M University, 2003. Available at <http://econweb.tamu.edu/dgoldberg/research/directed1.pdf>

Haberler, Gottfried. *Prosperity and Depression: A Theoretical Analysis of Cyclical Movements*. 4th ed., New York: Atheneum, 1963.

Horvath, Michael. "Cyclical and Sectoral Linkages: Aggregate Fluctuations from Sectoral Shocks." *Review of Economic Dynamics*, 1998, 1, pp. 781-808.

_____. "Sectoral Shocks and Aggregate Fluctuations." *Journal of Monetary Economics*, 2000, 45, pp. 69-106.

Jevons, W. Stanley. *Investigations in Currency and Finance*. London: Macmillan, 1909.

Keynes, John M. *The General Theory of Employment, Interest, and Money*. New York: Harcourt, Brace and Company, 1936.

Kiyotaki, Nobuhiro, and Randall Wright. "On Money as a Medium of Exchange." *Journal of Political Economy*, 1989, 97, pp. 927-54.

Leijonhufvud, Axel. *On Keynesian Economics and the Economics of Keynes: A Study in Monetary Theory*. New York: Oxford University Press, 1968.

Long, John, and Charles Plosser. "Real Business Cycles." *Journal of Political Economy*, 1983, 91, pp. 39-69.

_____. "Sectoral vs. Aggregate Shocks in the Business Cycle." *American Economic Review: Papers and Proceedings*, 1987, 77, pp. 333-6.

Mankiw, N. Gregory. "Real Business Cycles: A New Keynesian Perspective." *Journal of Economic Perspectives*, 1989, 3, pp. 79-90.

Mitchell, Wesley C. *Business Cycles: The Problem and its Setting*. New York: NBER, 1927.

Murphy, Kevin M., Andrei Shleifer, and Robert M. Vishny. "Building Blocks of Market Clearing Business Cycle Models," in Olivier J. Blanchard and Stanley Fischer, eds., *NBER Macroeconomics Annual 1989*. Cambridge, MA: MIT Press, 1989.

Scheinkman, Jose, and Michael Woodford. "Self-Organized Criticality and Economic Fluctuations." *American Economic Review: Papers and Proceedings*, 1994, 84, pp. 417-21.