The Economics of Deflation

Abstract

Deflation is difficult to analyze because of the need (i) to distinguish between different types of deflation, and (ii) to recognize that deflation differentially impacts agents and sectors. Nominal debt effects are central to the deflation process. Deflation has positive and negative effects on aggregate demand, making its ultimate impact theoretically ambiguous. Under reasonable assumptions it increases unemployment. This challenges the conventional wisdom that Keynesian unemployment is a special case resting on downward nominal wage and price rigidity. Flexible prices can aggravate unemployment. This speaks for institutions promoting downward rigidity of prices and nominal wages, but allowing upwardly flexible relative prices.

Key words: deflation, nominal debt, nominal wages, asset prices.

JEL ref: E0, E31
I The return of deflation: analytic preliminaries

Fifteen years ago deflation was widely viewed as an economic phenomenon of the past, a relic of economic history. In its place, inflation was viewed as the modern problem of monetary macroeconomics, the product of a shift to central bank fiat money based systems. Today, interest in deflation has made a roaring come back.¹

The current paper provides a comprehensive analytic treatment of the economics of deflation. The existing mainstream literature is seriously incomplete. It tends to conflate nominal and real wage deflation and it also tends to focus excessively on asset prices, perhaps owing to the bursting of speculative asset price bubbles in Japan in the early 1990s and the U.S. in 2000.² Figure 1 shows three different types of deflation, each of which requires different theoretical treatment. Deflation of speculative asset price bubbles is qualitatively different from generalized economy-wide deflation, which in turn is distinguishable from open economy exchange rate deflation (devaluation). Generalized deflation does impact asset prices by lowering firms’ nominal revenues and profits, but causation runs from developments in the economy to asset prices. Likewise, speculative asset price deflations impact the economy, but causation runs from asset prices to the economy. The principle focus of the current paper is generalized deflation.

¹ The resurgence of deflation is captured in an article in The Economist (November 23, 2002, p.67) which reported that newspaper stories about deflation surged in the third quarter of 2002 to their highest level since the 1930s. The R – word index, which counts stories about recession, has helped predict recessions. The fear is that a D – word index, which counts stories about deflation, may have predictive power about depressions. At the official level, the resurgence of interest in deflation is evidenced in a speech given by Federal Reserve Governor Ben Bernanke to the National Economists Club in Washington DC (November 21, 2002) titled “Deflation: Making Sure “It” Doesn’t Happen Here.” While acknowledging the problem of deflation, Bernanke discounted its threat, arguing that (1) flexible efficient labor and capital markets guard against deflation taking hold, (2) the Federal Reserve has lots of policy ammunition including further lowering of the federal funds rate, purchasing foreign and domestic government debt, and even making zero interest rate loans to the banking sector, and (3) exchange rate depreciation is another channel of action available to policy makers.
² This focus on asset deflation is visible in the IMF’s (2003) research. This focus may also be due to the role attributed to asset prices and collateral in theoretical models of the business cycle (Minsky, 1982; Bernanke, et al., 1999).
A first issue in analyzing generalized deflation is distinguishing between a one-time reduction in the price level and a steady continuing rate of decline in the price level. This distinction is akin to the distinction drawn in the 1960s monetarist debates regarding neutrality and super-neutrality of money. The former refers to one-time changes in the money supply, while the latter refers to a steady continuing rate of change of the money supply. With regard to deflation, the distinction is between neutrality and super-neutrality of prices. A second critical issue concerns the cause of generalized deflation. When prices fall there is need to identify the cause of decline as different causes have dramatically different economic consequences. The relationship between these issues is shown in Figure 1.

The structure of the paper is as follows. Section II explores how deflation differentially impacts sectors and agents. Section III presents a simple pricing model showing how price level reductions have different causes and how economic impact varies according to cause. There is no generic deflation. Instead, deflation must be analyzed according to its cause. Section IV describes the deflation transmission mechanism. Section V analyzes several important different types of price level deflation (neutrality). It distinguishes between “pure deflation” in which real wages and income shares are unchanged, “New Economy” deflation driven by accelerated productivity growth, and “Great Depression” deflation in which nominal wages fall but real wages rise. The aggregate impact of deflation is always theoretically ambiguous. Critical factors determining its impact include the size of the Fisher debt effect and whether the economy is wage- or profit-led. Section VI explores exchange rate deflation. Section VII explores the economic impact of steady continuous rates of price deflation (super-neutrality).
Section VIII combines the analysis of price level reductions (neutrality) with steady rates of price deflation (super-neutrality). If the Fisher debt effect dominates the Pigou and Keynes effects, then deflation is destabilizing in pure deflations where real wages and income shares are constant. Finally, section IX concludes the paper, noting that an analysis of deflation supports Keynes’ (1936) claim that demand-deficient unemployment may not be remedied by price and nominal wage reductions. Given that deflation can easily be destabilizing, policymakers should avoid deflation and guard against creating economic arrangements with excessive downward price and nominal wages flexibility.

II Theoretical preliminaries: debtors, creditors and the importance of heterogeneity

Figure 1 illustrates the need to distinguish between different types of deflation and different causes of deflation. A further complexity concerns the need to abandon the standard representative agent assumption and introduce heterogeneity of agents. A key channel whereby deflation impacts economic activity is fix-price nominal debt. However, a feature of debt is that it is simultaneously a financial liability to debtors and a financial asset for creditors. Thus, at a minimum, there is need to distinguish between debtors and creditors. At an accounting level, deflation increases the real burden of debts for debtors while generating an equal and opposite increase in the real value debts owed to creditors. The net impact on aggregate demand (AD) then depends on differences in the propensities to spend of debtors and creditors.

Beyond this, debtors and creditors may be households, firms, government, or financial intermediaries. Identifying deflation’s impact on AD therefore requires

---

3 Nominal debt effects are critical to the understanding of deflation. Fisher (1933) was the first to identify the significance of debt in his debt – deflation theory of the Depression.

4 Tobin (1980) emphasizes the significance of differences in the propensity to spend of debtors and creditors in his ISLM analysis of the effects of price level reductions.
accounting for differences in the responses of debtors and creditors across sectors, and
summing their impacts. The bottom line is that heterogeneity is key to understanding
deflation, another reason why it is so complex.

a) The impact of deflation on the household sector debtors

With regard to households, the impact of deflation depends critically on the
specification of the consumption function. Friedman’s (1956) permanent income
approach to consumption treats all households as having the same propensity to spend out of income and wealth. This implies that the negative impact of deflation on debtors is washed out by the positive impact on creditors. However, there are several arguments against this assumption. First, debtors and creditors may have different psychological dispositions. In particular, debtors may have a higher marginal propensity to consume. Second, debtor households may be liquidity constrained, which again makes for a higher marginal propensity to consume. Third, a Keynesian relative income consumption function has the marginal propensity to spend falling with income, and to the extent that debtors have lower incomes, they again have a higher marginal propensity to spend. All of these reasons suggest that increased burden of deflation on household debtors likely outweighs the gains for household creditors.

b) The impact of deflation on firm sector debtors

Firms are also impacted by deflation since many rely on debt finance, and deflation can have severe negative impacts on production and investment spending. Falling product prices reduce business’ nominal cash inflows, while nominal debt service outflows remain fixed. Net cash flows therefore fall, potentially constraining production and investment spending. This cash flow effect will have a net negative impact on AD if
it dominates the positive AD effect of deflation operating via wealthy individual investors and financial intermediaries who hold firms’ debt. To the extent that (i) firms’ investment spending is sensitive to net cash flows, (ii) wealthy individuals have a low marginal propensity to spend, and (iii) financial intermediaries only distribute part of their deflation windfalls and households only spend part of that distribution, then deflation-induced reductions in business cash flows will have a net negative impact on AD.

c) Deflation and the government sector

Government debt is also important in a deflationary environment, but unlike private sector debt, it can exert positive effects. These effects operate at both the stock and flow level. With regard to the stock effect, decreases in the price level increase the real value of government bond holdings, thereby inducing a positive household wealth effect. With regard to the flow effect, deflation tends to increase the real government deficit, thereby having a positive effect on AD. Though taxes and spending decline proportionately, the stream of nominal debt interest payments to households is unchanged and stimulates consumption spending. The same logic also applies to fixed nominal transfer programs such as Social Security.

The impact of deflation on the deficit can be seen from the government budget constraint given by

\[ B = P[G - tY] + iD_G \]

where \( B = \) budget deficit or surplus, \( P = \) price level, \( G = \) real government spending, \( t = \) average tax rate, \( Y = \) real GDP, \( I = \) nominal interest rate, and \( D_G = \) government debt. A

---

5 As with all discussions of government liabilities, this result is contingent on government debt being net wealth. If the neo-Ricardian hypothesis (Barro, 1974) holds, then government bonds are not wealth, being matched by an equal future tax liability. However, theory and evidence both suggest that government bonds are net wealth.
fall in the price level increases the real value of debt service payments, thereby increasing the real deficit.

How the increase in the real deficit is addressed also matters. Cutting government spending will be contractionary owing to the familiar balanced budget multiplier theorem: one dollar reduction in government spending causes one dollar loss of AD, but households only spend a fraction of each dollar of debt service received. If financed by bond sales or increases in the monetary base, the increased deficit is expansionary. Unaccommodated bond financing will generate some crowding out as predicted by standard ISLM analysis (Christ, 1968; Blinder and Solow, 1973; Tobin, 1979). With money financing, there is no crowding out and the expansionary government deficit effect of deflation is strongest.

d) Deflation and the foreign sector

Deflation also impacts the foreign sector. Assuming fixed exchange rates, domestic price deflation will increase competitiveness and raise AD by stimulating exports and reducing imports. In addition, there will be important foreign asset wealth and income effects. The sign of these effects depends critically on whether households and firms are foreign currency creditors or debtors. If creditors, a lower domestic price level raises the domestic currency value of foreign asset holdings, and it also raises the domestic currency value of income on those assets. Both of these effects are positive. Conversely, if households and firms are foreign debtors, the effects work in reverse and are contractionary.

For households, the AD effects of changed real domestic currency values of foreign asset holdings and foreign income streams, work through (i) a consumption
wealth effect based on changed foreign asset values, (ii) a disposable income effect resulting from changes in the value of net foreign income, and (iii) changes in the value of dividends from firms whose profits are impacted by corporate foreign debt service payments. For firms, foreign debt service impacts cash-flows, which then affects investment spending.

A further complicating factor is that households and firms may have differential debtor-creditor positions. Thus, households may be net foreign creditors, while firms are net foreign debtors. In this case the foreign wealth and foreign income impacts of domestic price deflation are ambiguous. The household sector is made better off, while the firm sector is made worse off. The net effect then depends on the relative sensitivities of consumption and investment spending to changes in foreign income positions.

Note, the above analysis is contingent on fixed exchange rates. If nominal exchange rates are determined according to purchasing power parity, then the nominal exchange rate adjusts to fully neutralize domestic price level reductions. This leaves the domestic real value of foreign income and foreign debt service payments unchanged. Alternatively, if exchange rates are flexible but adjustment is incomplete, there will be some real appreciation in response to domestic deflation. In this case, there is an increase in the real value of foreign income and debt service payments, but the increase is less than under fixed exchange rates.

e) Financial intermediaries and the deflation process

Finally, there are financial intermediaries (FIs), who link debtors and creditors. Gains from deflation initially accrue to FIs, and the extent to which these gains feed into AD depends on the extent to which FIs distribute them to the ultimate owners. The more
gains that FIs retain, the smaller the gains that feed into AD through creditor household spending. However, losses from deflation are still fully felt by debtor households. Consequently, FIs likely increase the deflation’s negative impact on AD.

**III Further theoretical preliminaries: a simple model of price formation**

A logical starting point for an analysis of price and wage deflation is the standard Kaleckian mark-up pricing model. This model recognizes the binding link between prices, nominal wages, the mark-up, and the average product of labor. Too often analyses of deflation proceed without recognizing that price level change implicitly involves change in the nominal wage, the mark-up, or average labor productivity. The impact of these changes must be accounted for, along with the impact of a changed price level.

The basic logic of the Kaleckian pricing model is that firms charge a mark-up over average labor costs. For simplicity the average product of labor is initially assumed constant, and scale effects are discussed later. Firms’ prices are determined according to

\[ P = [1 + m] \frac{W}{a} \]

where \( P \) = price, \( m \) = exogenously given mark-up, \( W \) = nominal wage, and \( a \) = average product of labor. Manipulating equation (2) yields the real wage, which is given by

\[ \frac{W}{P} = \frac{a}{1 + m} \]

Lastly, it can be shown that the wage and profit shares can be stated as

\[ s_w = \frac{1}{1 + m} \]

\[ s_p = \frac{m}{1 + m} \]

\[ s_w + s_p = 1 \]

---

\(^6\) The wage share is given by \( s_w = WN/PaN \) where \( N \) = level of employment. Substituting for \( P \) using equation (2) then yields the expression for the wage share. Using the adding up constraint on wage and profit shares given by equation (6) and the expression for the wage share, then yields an expression for the profit share.
where $s_w =$ wage share and $s_p =$ profit share. This simple model illustrates how prices, nominal wages, mark-ups, productivity, and real wages are tied together. Price level reductions can occur because of lowered nominal wages, a lowered mark-up, or a higher average product of labor. Contrastingly, real wage reductions are driven by increased mark-ups or a lowered average product of labor, but these changes cause the price level to increase.

A difficulty in analyzing the economic effects of deflation is the need to distinguish between the effects of price deflation, nominal wage deflation, and real wage deflation. These can occur in multiple combinations, and economic outcomes differ according to the particular combination. The above simple model with just three parameters – $W$, $m$, and $a$ – is capable of generating an array of combinations, as shown in Table 1. Consequently, it is not possible to talk of “generic” deflation. Instead, there is need to analyze the particular deflationary configuration.

The second challenge is to identify how price and wage deflation feed into the macro economy. Figure 2 provides a schematic outline of this process. Price, nominal wage, and real wage deflation feed into the deflation transmission mechanism, which in turn impacts the level of AD. The level of AD then impacts output and employment. Thereafter, there are multiple secondary feedback loops. Changing output and employment levels give rise to traditional Keynesian expenditure multiplier effects that feedback into the transmission mechanism and impact AD. There may also be labor market effects as changed employment conditions impact nominal wages, and nominal wage change then feeds through to impact prices through the price mark-up equation. Within firms, there can also be scale effects that impact the average product of labor. If
there are increasing returns to scale, or if firms have U-shaped average cost structures and are producing at the bottom of the U, output reductions will cause costs and prices to rise. Finally, there can be product market competition effects, with reduced AD and output contributing to increased competition and lower mark-ups. These scale and mark-up effects feedback and affect prices and real wages.

IV The deflation transmission mechanism

Section II identified the importance of heterogeneity effects, while section III presented a pricing model that showed how deflation could have different causes. Deflation feeds into the economy via the deflation transmission mechanism, which has some analogies with the monetary transmission mechanism. Figure 3 shows the deflation transmission mechanism.

Deflation impacts the government, the household sector, the firm sector, and the financial sector. Government is impacted via the budget deficit as discussed in section II, and how policy responds to the increased real deficit arising from the increased burden of debt service, determines the impact on AD. Households are impacted by changes in the real wage, the wage share, debt service burdens, and the value of financial assets. These changes in turn impact aggregate consumption spending. Firms are impacted by changes in profits, the profit share, debt service burdens and net cash flows, and changes in foreign sector competitiveness. These changes affect production, employment and investment spending decisions. The financial sector is impacted by changed balance sheet collateral values, changes in the real money supply that impact the cost of capital, and

---

7 How mark-ups respond to the business cycle is a controversial empirical issue (see Rotemberg and Saloner, 1986).
changes in financial intermediation capacity. These changes impact the financial sectors
willingness and capacity to lend to finance investment and consumption spending.

The financial intermediation capacity effects reflect the fact that deflation can
trigger debt default, and the writing-off of bad debts in turn erodes financial intermediary
equity and capacity to lend. In the extreme, if loan losses are large, it can even trigger
bank runs that destroy the financial sector. Another way in which financial intermediation
capacity is destroyed is through the destruction of information. Thus, deflation may
compel a firm to default on its debts. If the firm continues as a going-concern its credit
reputation is now tainted, limiting its possibilities to expand and grow. Alternatively, the
firm may be wound-up and sold, in which case lender information regarding the business
is lost. These deflation-induced financial disintermediation and organization capital
destruction effects have been emphasized by Bernanke (1983) in his analysis of the Great
Depression. They are undoubtedly important, and akin to changes in the economy’s
resource endowment. However, they are qualitatively different from standard
macroeconomic factors. For this reason, they are abstracted from in the balance of the
paper.8

Together, Figures 2 and 3 provide a flow diagram analysis of the economic effects
of deflation. Appendix I presents a formal macro model that incorporates the full
deflation transmission mechanism. The model can be used to derive formal comparative
static results but, as discussed below, signings are ambiguous because deflation induces
opposite signed effects on debtors and creditors. In general, if (i) the impact on debtors is

---
8 Analyticaly, the capacity of FIs to intermediate can be captured by having the coefficient of asset
collateral values in the investment function (see Appendix I, equation (A.7)) depend positively on FI
capacity. Thus, if defaults destroy FI capacity, then a given level of collateral will have a smaller impact on
aggregate investment spending since FIs will be less willing to finance spending.
stronger than that on creditors, and (ii) reductions in the real wage and wage share lower AD, deflation will reduce employment and output.

V An analysis of different types of deflation

The previous sections have established the theoretical preliminaries necessary to analyze deflation. First, there is need to account for the heterogeneous impact of deflation across different agents and sectors. Second, there is need to account for the different causes of deflation which give rise to different types of deflation. Table 1 outlines some different types of deflation involving different combinations of price deflation, nominal wage deflation, and real wage deflation. Nominal wage deflation can co-exist with real wage deflation or real wage inflation. This complicates the analysis of deflation since the impact of both nominal and real wage deflation must be taken into account.

a) Pure nominal deflation: price and nominal wage deflation with unchanged real wages. Case (1) corresponds to pure nominal deflation, and is the natural starting point. Real wages and the wage share are unchanged, since the mark-up (m) and the average product of labor (a) are unchanged. However, lower nominal wages cause a reduction in prices via the price equation.\(^9\) Table 2 disaggregates the resulting effects. Since the real wage and the mark-up are unchanged, there are no real wage or wage share effects. However, reduced nominal wages increase the burden of debtor household debt service. Balanced against this, creditor households see an increase in the real value of their interest income. If debtor households have a higher marginal propensity to spend than

---

\(^9\) The case of pure nominal wage and price change is the case usually examined in the IS/LM model. Such analysis tends to only incorporate the Pigou (1943) real balance and Keynes money supply effects, and ignores all the other changes in Figure 2. Kaleckians have also emphasized this case, arguing that lower nominal wages result in lower prices, leaving real wages and real aggregate demand unchanged. In their formulation, lower nominal wages lead to an equi-proportionate downward shift of the aggregate demand and aggregate supply schedules, leaving real output unchanged. However, such Kaleckian analysis is even less complete since it ignores the existence of both fix price nominally denominated assets and liabilities.
creditor households, AD will be diminished. In addition, there is a positive real balance wealth effect resulting from the effect of lower prices on the real value of money holdings. But balanced against this, lower prices stand to diminish the equity value of firms by increasing firms’ debt service obligations.

Whereas inside debt service effects can have a negative impact on the household sector, government debt service payments to households will be expansionary – especially if paid for by increases in the monetary base. Finally, assuming fixed exchange rates, the real value of foreign income will earnings will also increase if the household sector is a net foreign creditor – which increases consumption. The effect will be the opposite if the household sector is a net foreign debtor.

As regards firms, since the mark-up is unchanged, there are no initial profit or profit share effects. However, as with households, there is a firm debt-service effect as firms are also debtors, and servicing their debts entails a fixed nominal cash outflow. Net cash flow consists of sales revenue minus the nominal wage bill minus debt service. Deflation reduces product prices and firms’ sales revenues, and it also reduces the nominal wage bill proportionately. However, debt service (both domestic and foreign) is unchanged. Consequently, real net cash flow is reduced. If firms’ investment plans are cash flow constrained, then investment may fall. In addition, if production decisions are cash flow constrained, production and employment could also be reduced. Empirically, there is robust microeconomic evidence that firms’ investment plans are affected by cash flows (Fazarri et al., 1988). Finally, given fixed nominal exchange rates, lower prices will increase the competitiveness of domestic firms vis-à-vis foreign firms. This increases exports and lower imports, thereby increasing AD.
Lastly, the financial sector is impacted by a lower price level, which increases the real value of the money supply (the Keynes effect). This effect is emphasized in neo-Keynesian IS/LM economics, and makes for lower interest rates (absent an interest rate floor), which increases investment spending. But offsetting this, the decline in nominal revenues and the increase in the burden of firm debts reduce the collateral value of assets.

In sum, there are positive and negative AD effects from deflation. The stronger the household and firm debt service effect, the more likely that the net AD impact will be negative. Lower nominal wages can therefore reduce output and raise unemployment, as suggested by Keynes in Chapter 19 of *The General Theory*. This is without accounting for financial intermediation capacity destruction effects that can result from debt defaults that cause the banking and credit system to implode.

**b) Real wage deflation: price inflation with unchanged nominal wages.** Case (1) has lower nominal wages with unchanged real wages. Case (5) has the reverse situation of unchanged nominal wages with lower real wages. This case has been extensively investigated by Bhaduri and Marglin (1990) in connection with the question whether real wage reductions can restore full employment. Inspection of the real wage equation shows that real wage deflation must be brought about by a combination of an increased mark-up (m) or a decrease in the average product of labor (a). From the price equation, it then follows that the price level must rise.

For current purposes the analysis focuses on the case of an increased mark-up. The income share equations then show that the wage share falls and the profit share rises. The employment and output implications of a lower real wage and wage share have been analyzed by Bhaduri and Marglin (1990), and the outcome depends on whether the
economy is “wage-led” or “profit-led.” A wage-led economy is one in which the negative consumption effects of a reduced real wage dominate the positive investment effect of an increased profit share. A profit-led economy has the reverse response.

The real wage share analysis of Bhaduri and Marglin is important, but it is also incomplete because it omits nominal considerations. Factors that cause changed real wages also generate price level effects that impact firms, households, and financial markets. These price level effects can significantly alter the analysis.

Table 2 again disaggregates the effects. With nominal wages unchanged, there are no household debtor effects. However, higher prices reduce the debt service income of household creditors, reducing their consumption spending. The increase in the price level also causes a negative real balance effect that reduces household wealth. However, higher prices increase the value of equities, which is positive for consumption.

With regard to firms, the increase in the price level positively impacts cash flows, which facilitates financing of investment. This is positive for AD. If the economy is profit-led, these changes amplify the positive AD impact of an increased profit share. If the economy is “weakly” wage-led, these positive firm cash-flow effects mean that output and employment could still expand. However, if the economy is “strongly” wage-led, then the negative AD effect of a lower wage share causes a reduction in output. If this output reduction is sufficiently large, firm cash flows could decline and amplify the output decline. Lastly, given fixed exchange rates, a higher price level will cause negative foreign sector competitiveness effects that reduce AD by reducing exports and inducing substitution of domestic demand toward imports.
With regard to the financial sector, a higher price level causes a negative Keynes real money supply effect. Absent, an increase in the nominal money supply, this will tend to raise interest rates and the cost of capital, adversely affecting investment spending. However, a higher price level increases firms’ cash flows which increases balance sheet collateral values, facilitating lending to liquidity constrained firms. This is positive for investment.

c) New Economy deflation: price deflation, unchanged nominal wages, and real wage inflation. A third case is that of unchanged nominal wages, falling prices, and rising real wages. This case corresponds to one in which average labor productivity increases, and is of interest because it captures notions of a “New Economy” driven by wave of technological innovation.

Since the mark-up is unchanged there is no change in the wage or profit share. There are also no nominal wage impacts. However, prices fall owing to higher labor productivity. The fall in prices is positive for households, increasing real wages, real balances, the real value of government debt service payments, and the real value of foreign income streams. The firm sector benefits from increased competitiveness relative to foreign firms.

The one problem concerns the impact of higher productivity on employment. This links to Alvin Hansen’s notion of technological unemployment. With AD unchanged, employment initially decreases. However, AD is positively impacted by productivity-driven lower prices. The critical question is whether the increase in AD is sufficient to absorb the increase in output caused by higher productivity. If not, employment falls, triggering adverse multiplier effects as households cut back on consumption spending.
The possibility of technologically induced unemployment is captured in Figure 4. The economy is initially in equilibrium with output of \( y_0 \) and employment of \( N_0 \). Now, suppose there is an improvement in technology that rotates the production function to the left as in Figure 4. Higher labor productivity then generates a lower price level via the price mark-up equation, which shifts up the AD function – there are no adverse consequences for debtors. If AD is very price elastic, the AD function shifts up significantly, and output and employment rise. However, if AD is price inelastic, the shift is small and employment falls. Finally, note that output may increase significantly while prices and employment both fall.\(^{10}\)

\( d)\) Comprehensive deflation: price deflation, nominal wage deflation, and real wage deflation. Case (3) constitutes comprehensive deflation in which prices, nominal wages, and real wages all fall. It therefore combines cases (1) and (7), giving rise to the possibility of conflicting nominal and real wage effects.

If the economy is wage-led, the reduction in real wages is contractionary. This reinforces the adverse effects stemming from increased nominal debt burdens, so that AD and output fall. However, if the economy is profit-led, the fall in real wages stimulates investment and AD. This counters the adverse effects of increased nominal debt burdens, leaving the final outcome ambiguous. This ambiguity of outcome is captured in Figure 5. A lower real wage share can increase (+) or decrease (-) economic activity. Likewise, lower nominal wages can decrease (debt effects dominate) or increase (real balance effects dominate) economic activity. Output unambiguously falls when the economy is

\(^{10}\) Productivity advance may occur at a differential rate across sectors. In this case, fast growing sectors may be subject to similar technologically induced employment declines. Moreover, the impact stands to be worse in that the own real interest rate in these sectors will be higher. This is because these sectors face the economy wide nominal interest rate, but have a faster rate of own-price decline. This will tend to hold back investment spending in these sectors.
wage-led and debt effects dominate. It unambiguously rises when the economy is profit-led and real balance effects dominate. In the other two instances the direction of change is uncertain, and depends on the relative strengths of the effects.

e) The Great Depression: price deflation, nominal wage deflation, and real wage inflation. A last interesting case is where nominal and real wages move in opposite directions. In some regards, this case resembles the Great Depression in which prices showed greater downward flexibility than nominal wages, so that real wages rose slightly. Figure 6 describes the possible set of outcomes under this configuration. Output unambiguously contracts if the economy is profit-led and nominal debt effects dominate. It unambiguously expands if the economy is wage-led and real balance effects dominate. In the other two instances the outcome is ambiguous.

VI Exchange rate deflation

Lowered domestic prices and nominal wages have important implications for the real value of foreign income streams and foreign debt service obligations. Under fixed exchange rates, agents that are net foreign currency creditors are better off because the domestic purchasing power of their foreign income streams increases. Conversely, agents that are net foreign currency debtors are worse off because the domestic currency burden of their foreign debt payments rise.

Exchange rate devaluation can be viewed as equivalent to one-off deflation of the exchange rate, and its aggregate economic impact depends importantly on whether agents are net foreign creditors or debtors. Figure 7 describes the transmission channel for exchange rate deflation. The effect on households operates via impact on household net foreign income and foreign asset values. If the household sector is a net foreign currency
creditor, exchange rate devaluation increases the domestic currency value of foreign
income and foreign asset holdings, stimulating consumption spending.

The effect on the firm sector is more complicated. First, exchange rate
devaluation strengthens the competitive position of firms, raising exports and lowering
imports. This is expansionary. However, it also raises the price of imported inputs, which
weakens the competitiveness of domestic firms. If the firm sector is a net foreign
currency creditor, exchange rate devaluation increases the domestic cash flow
contribution of foreign income. It also increases the collateral value of foreign assets.
Both of these developments strengthen firms’ financial positions, stimulating investment
spending. This is expansionary. Conversely, if the firm sector is a net foreign currency
debtor, these two impacts are contractionary.

**VII Deflation and the super-neutrality of prices**

Thus far the analysis has focused on the impact of one-time changes in the level
of prices and nominal wages. A second important question is the impact of steady
sustained reductions in prices and nominal wages. Mundell (1963) and Tobin (1965,
1975) emphasize how steady expected rates of change in the price level affect the pattern
of asset demands. Sustained deflation increases the value of money, thereby inducing a
portfolio shift away from capital to money. This portfolio effect drives up the required
return on physical capital which must compete for a place in agents’ portfolios, thereby
reducing investment spending. The deflation portfolio effect is illustrated by the ISLM
diagram in Figure 8.1, which is constructed under the assumption of perfect foresight so
that expected deflation equals actual. Deflation increases money demand, which shifts the
LM to the left, resulting in a new equilibrium in which the gap between the nominal and
real interest rates is equal to the rate of deflation. Relative to the initial equilibrium, nominal rates fall slightly, real rates rise, and output is lower.

Figure 8.2 analyzes the deflation portfolio effect under conditions of pegged nominal interest rates. In this case, the impact on real output is even larger, since now there is no endogenous downward adjustment of the nominal interest rate as output falls. Consequently, the real interest rate rises even further, and the decline in output is larger.

The Tobin portfolio effect operates on the LM schedule. In addition, there are IS effects that operate through household and firm spending behavior. These IS effects result from inter-temporal substitution in consumption and investment spending. Thus, the prospect of lower future prices can induce households to postpone consumption decisions and increase saving, and firms may also delay investment spending decisions. These additional IS effects are captured in Figure 8.3. The net result is an even larger fall in real output, but the rise in real interest rates is mitigated by reduced output demand.

In addition to this negative inter-temporal relative price substitution effect, sustained deflation also imposes a negative wealth effect on households that further reduces consumption spending. This is because deflation reduces the value of future profits, which in turn lowers the current nominal value of firms’ equity. The present discounted value of firms’ profits and the evolution of the price level are given by

\[
V = \sum_{j=0}^{n} \left[ P_{ij} Y_{ij} - W_{ij} - i_{ij} D_{ij} - i^*_{ij} D^*_{ij} / e_{ij} \right] / (1 + i_{ij}) \quad j = 0, \ldots, n
\]

\[
P_{ij} = [1 + \pi_{ij}] P_{ij-1}
\]

---

11 These IS spending effects are obscured in standard ISLM models. However, they are clearly evident in Tobin (1982) styled end-of-period ISLM models which properly account for the relation between asset stock demands and asset accumulation decisions. These IS effects have also been emphasized by Krugman (1998), although he misleadingly talks about them in terms of the liquidity trap.
where $V =$ present value, $P =$ price level, $Y =$ real output, $W =$ nominal wage, $N =$ employment, $i =$ domestic interest rate, $DF =$ firms’ debt, $i^* =$ foreign interest rate, $D^*_F =$ firms’ foreign debt (or assets), $e =$ exchange rate (units of foreign currency per unit of domestic currency), and $\pi =$ rate of deflation. Assuming an unchanged real wage - so that prices and nominal wages fall together - and unchanged output and employment levels, deflation reduces the present value of profits because debt service payments remain fixed in nominal terms. Household wealth is therefore reduced, causing a negative consumption wealth effect on the IS schedule that is additional to the inter-temporal substitution effect.

Finally, Figure 8.4 shows the combined impact of the portfolio and inter-temporal spending substitution effects under conditions of a nominal interest rate floor. In this case the fall in income and increase in real interest rates is even larger. This is because the nominal interest rate floor prevents the nominal interest rate from adjusting down to partially offset the impact of reduced spending. The root cause of the nominal interest rate floor is the zero bound on nominal interest rates, whereby agents always have the option of holding zero-interest bearing money. However, the actual nominal interest rate floor will likely lie above this zero bound for several reasons. First, holding money yields a liquidity service yield that bonds must match. Second, at extremely low interest rates there is the possibility of a future interest rate reversal that threatens capital losses on bonds, and bonds must therefore compensate for this risk. Third, buying and selling bonds involves transaction costs, and there are also default risks – which may be positively related to the rate of deflation. Bonds must therefore also compensate for these costs and risks. Putting the pieces together, the nominal interest rate floor can be given by

\[
22
\]
where \( l = \) liquidity premium, \( c = \) capital loss premium, and \( t = \) transaction cost premium.

From a policy standpoint, the significance of this floor is that it can render monetary policy ineffective. This is shown in Figure 8.4, where \( y^* \) is the full employment level of output. Given a rate of deflation of \( \pi_1 \), obtaining full employment output calls for a nominal interest rate of \( i^* \) - which is below the nominal interest rate floor. At this stage, monetary policy is ineffective, and policy authorities must rely on instruments (such as fiscal policy) that can shift the IS schedule.

Lastly, in addition to the above ISLM demand side consequences, deflation can also exert adverse supply-side effects that also reduce output and employment. These supply-side effects are examined in Palley (1997) in a model in which production takes time, and firms produce on the basis of expected levels of future aggregate demand. Because production takes time, production expenses are incurred in advance of sales revenue. With falling prices, firms may be unable to recover their production costs, leading them to reduce output. Again, there is the possibility for instability, as lower output levels contribute to falling nominal wages that worsen debt burdens and lower aggregate demand. This leads to expectations of lower future aggregate demand, resulting in further cutbacks in the level of production. Thus, in a Keynesian model of production, adverse aggregate demand effects of deflation can spill over into the supply calculus of firms, aggravating the adverse impact of deflation. Moreover, such supply calculus can also lower investment spending for similar reasons. This is because firms pay for long-lived capital goods upfront, and these goods pay for themselves over time. However, falling prices reduce the stream of future nominal revenues from these capital goods, so
that firms may be unable to recover their initial money costs. Consequently, investment spending may fall.

VIII Combining analysis of price neutrality and super-neutrality

Thus far the analysis has treated one-time price level reductions (neutrality) and steady continuous rates of decline of prices (super-neutrality) separately. This section combines the two effects in a unified analysis that draws on Tobin (1975). Economic activity and the rate of price deflation is determined as follows

\[ y = E(i(M/P, \pi^e) - \pi_e, \pi, M/P, D/P) \]

\[ \omega = f(y - y^*, \pi_{-1}, ..., \pi_{-t} ... ) \quad f(0) = 0, f' > 0 \]

\[ \pi = \omega \]

\[ \pi^e = \pi \]

where \( y \) = output, \( i \) = nominal interest rate, \( M \) = nominal money supply, \( P \) = price level, \( \pi^e \) = expected deflation, \( \pi \) = actual inflation, \( D \) = nominal debt, \( y^* \) = potential output, and \( \omega \) = rate of nominal wage deflation. Equation (10) has output equal to AD. AD depends negatively on the expected real interest rate, negatively on expected deflation (the spending delay effect), positively on the real money supply (the Pigou effect), and negatively on real debt (the Fisher debt effect). The nominal interest rate depends negatively on the real money supply (the Keynes effect) and negatively on expected deflation (the Tobin-Mundell effect). Equation (11) determines the rate of nominal wage deflation, which is determined by a Phillips curve anchored on full employment output. Equation (12) has price deflation equal to nominal wage deflation so that real wages are unchanged, and equation (13) has expected deflation equal to actual deflation so that
agents have perfect foresight. Now, when the economy falls below full employment output, nominal wages start to fall and this is passed through into price deflation.\textsuperscript{12}

Figure 9.1 shows a family of negatively sloped iso-AD contours drawn in nominal wage – expected rate of price deflation space. The contours are drawn under the assumption that the Pigou real balance and Keynes money supply effects dominate the Fisher debt burden effect. The logic of the slope is as follows. A lower price level increases AD owing to the dominance of the Keynes and Pigou effects. This then calls for a faster rate of deflation that increases the Tobin-Mundell effect and also increases the consumption and investment spending delay effect. These combined effects lower AD, thereby holding the overall level of AD unchanged. The contours are also ranked by level of AD, with lower contours corresponding to a higher level of AD. The reason is that a lower price level, holding the rate of deflation constant, increases AD because of the Pigou and Keynes effects.

The stability of the deflation process depends on the slope of the AD contours and the speed of adjustment of deflation expectations. Figure 9.1 shows two price adjustment paths. Along the steeper path deflation expectations change little as the price level falls, and the economy moves to a higher level of AD so that continued price level reduction eventually restores full employment. However, along the flatter path the economy moves to a lower level of AD so that continued price level reduction moves the economy further away from full employment. The reason is that falls in the price level generate large

\textsuperscript{12} Increased sensitivity of the rate of deflation to the output gap can be destabilizing (Caskey and Fazzari, 1987; Tobin 1993). This is because greater sensitivity leads to expectations of even more rapid deflation which exerts a negative impact on AD. Thus, even if a lower price level increases AD (which is contestable because of nominal debt service burden effects), this effect may be overwhelmed by the adverse impact of more rapid deflation.
increases in deflation expectations, which trigger a negative Tobin-Mundell effect and a negative consumption and investment spending delay effect.

Figure 9.2 describes the case where the Fisher debt burden effect dominates the Pigou and Keynes effects. In this case the iso-AD contours are negatively sloped. The logic is that a lower price level lowers AD owing to the dominance of the Fisher debt effect, and this calls for a lower rate of deflation (reduced Tobin-Mundell effect) to offset it. In addition, lower iso-AD contours now correspond to lower levels of AD. The reason is that a lower price level, holding deflation expectations constant, lowers AD owing to the dominance of the Fisher debt effect.

Inspection of Figure 9.2 shows that all price adjustment paths are unstable. Once the economy is below full employment and prices start falling owing to a negative output gap, the economy is driven further away from full employment. This holds even if prices and nominal wages fall instantaneously in Walrasian fashion, with no impact on deflation expectations (i.e. the case where the price adjustment path is vertical).

IX Conclusion and policy findings

Deflation is very complex and difficult to analyze. Its impact varies across sectors and agent type, and it is important to distinguish between the effects of one-time price level reductions and steady continuous declines in the price level. Deflation can result from many different causes, and its impact varies by cause. Consequently, there is no generic deflation, and instead it must be analyzed on the basis of specific causal factors. Real wages and the wage share can rise even as nominal wages fall. Since deflation has both positive and negative effects on AD, its overall impact is always theoretically ambiguous. However, if the Fisher debt effect dominates the Pigou and Keynes effects,
then deflation is always destabilizing and increases unemployment in “pure deflations” where the real wage and income shares are constant.

At the theoretical level, the paper provides a comprehensive taxonomy of deflation, and highlights why each type must be analyzed separately. It also provides new insights into New Economy deflation driven by productivity advance, and explains how this can cause technological unemployment. Most importantly, the paper provides justification for Keynes’ (1936) claim to have provided a theory of equilibrium unemployment in a monetary production economy. The economics profession has long insisted that Keynes’ analysis represents a special case predicated on downward price and nominal wage rigidity. An analysis of deflation with inside debt rejects this conventional wisdom and explains why a lower price level and deflation may increase unemployment. Lastly, the paper sheds new light on the macroeconomic consequences of real wage deflation, an issue that has been examined by Bhaduri and Marglin (1990). Real wage change implies some form of nominal wage change, price change, or combination of both. These nominal changes have important consequences, but they have been ignored in existing analyses. The current paper remedies this lacuna.

The paper also has important policy implications. The conventional wisdom in the economics profession is that deflation can restore full employment. In practice, owing to Japan’s recent experience with deflation, policy makers now recognize the dangers of

---

13 Keynes’ (1936) claimed to have provided a theory of unemployment in a monetary production economy that was not dependent on downward price and nominal wage rigidity. Pigou (1943) and Modigliani (1944) challenged this claim, and argued that Keynesian unemployment was a special case that depended on downward rigidities. Keynes’ claim was re-opened in the 1960s by Leijohufvud, but it was then rejected by the fix-price general disequilibrium paradigm pioneered by Barro and Grossman (1971). This paradigm has since become the foundation of neo-Keynesian economics. Moreover, emphasis on downward price rigidity (albeit now supported by an optimizing microeconomic foundation) remains the dominant theoretical approach to macroeconomics. Thus, the contemporary conventional wisdom is that absent downward price and nominal wage rigidity, the macro economy would automatically return to full employment.
deflation and recommend macroeconomic policies aimed at avoiding deflation.\textsuperscript{14} However, though practical macro policy has come around, policymakers continue to advocate microeconomic policies that push nominal wage flexibility and promote structures that facilitate deflation.

This points to a dissonance between macroeconomic theory and macroeconomic policy, and between macroeconomic policy and microeconomic policy. Whereas textbook economic theory continues to assert that downward price and wage rigidity is the cause of unemployment, macroeconomic policymakers are actually committed to avoiding deflation. Yet, even as policymakers have become cognizant of the macroeconomic dangers of deflation, they continue to promote microeconomic policies that make deflation more likely. These policies push market reforms that increase price and wage flexibility, thereby increasing the likelihood of deflation.

A Keynesian perspective provides a different theoretical account and different policy recommendations. Rather than being the cause of unemployment, downward inflexibility of nominal wages and prices is a source of stability in modern financial economies with extensive financial intermediation and inside debt. Maintaining full employment requires that prices and nominal wages be upwardly flexible, but capable of relative adjustment to facilitate resource reallocation. The problem is that in recessions there are no market forces generating upward pressure on prices and nominal wages. Instead, all pressure is downward. This is why Keynesian counter-cyclical fiscal and investment policies are needed. It is also the reason for institutions such as trade unions

\textsuperscript{14} In this vein, a recent IMF taskforce on deflation talks of the policy response to deflation in the following terms: “Given the costs of deflation, it is desirable to prevent it from taking root, rather than deal with it once it has become entrenched.....A vigorous policy response may be required....Preventing deflation in a low inflation environment requires preemptive and possibly aggressive action (IMF, 2003, p.31-32).”
and minimum wages that bar against deflation. However, for the last thirty years, policy has worked for the dismantling of these institutions. The danger is that this process may have gone sufficiently far to restore 19th century style deflation as a permanent threat.
Appendix I: the neutrality of prices

Figures 1 and 2 provide a flow diagrammatic analysis of the way in which deflation impacts the economy. The appendix provides a simple static model described by the following set of equations:

**Prices and real wages**

(A.1) \( P = (1 + m)W/a \) \( m > 0, \ a > 0 \)

(A.2) \( W/P = a/(1 + m) \)

**Aggregate demand and output**

(A.3) \( Y = AD \)

(A.4) \( Y = aN \) \( a > 0 \)

(A.5) \( AD = C + I + G + X - M \)

(A.6) \( C = \{c_0[H + V + D_G + D^*_H/e] + c_1[1 - t][\theta WN - iD_w] + c_2[1-t]Max[0, \gamma (PY - WN - iD_F - i^*D_F/e)]\} + c_3[1-t][\theta WN + iD_w + iD_F + iD_G + i^*D^*_H/e]/P \) \( 0 < c_0 < 1, 0 < c_2 < c_1 < 1, 0 < \theta < 1, 0 < \gamma < 1, 0 < t < 1 \)

(A.7) \( I = \alpha_0 + \alpha_1[i-\pi] + \alpha_2 Y + \alpha_3 CF + \alpha_4 V \) \( \alpha_1 < 0, \ \alpha_0, \ \alpha_2, \ \alpha_3, \ \alpha_4 > 0 \)

(A.8) \( CF = \text{Min}[Y - WN - iD_F - i^*D_F/e, (1 - \gamma)[PY - WN - iD_F - i^*D_F/e]/P] \) \( 0 < \gamma < 1 \)

(A.9) \( X = X(eP/P^*) \) \( X^* < 0 \)

(A.10) \( M = \beta(eP/P^*)C \) \( 0 < \beta < 1, \ \beta^* > 0 \)

**Financial sector**

(A.11) \( V = z[PY - WN - iD_F - i^*D_F/e]/iP \) \( z > 0 \)

(A.12) \( m(i)H/P = L(i, \ Y) \) \( m_i > 0, \ L_i < 0, \ L_Y > 0 \)

**Government sector**

(A.13) \( B = P[G - tY] + iD_G = \Delta H + \Delta D_G \)

where \( P = \text{price}, \ m = \text{exogenously given mark-up}, \ W = \text{nominal wage}, \ a = \text{average product of labor}, \ Y = \text{real GDP}, \ AD = \text{real aggregate demand}, \ C = \text{aggregate consumption}, \ I = \text{investment}, \ G = \text{government spending}, \ X = \text{exports}, \ M = \text{Imports}, \ L = \text{nominal money supply}, \ V = \text{stock market value of firms}, \ N = \text{employment}, \ i = \text{domestic interest rate}, \ i^* = \text{foreign interest rate}, \ D_w = \text{household debt}, \ D^*_H = \text{foreign assets/debts of households}, \ D_F = \text{domestic debt of firms}, \ D^*_F = \text{foreign assets/debts of firms CF = firms’ cash flows}, \ e = \text{nominal exchange rate (units of foreign currency per unit of domestic currency)}, \ P^* = \text{foreign price level}, \ H = \text{monetary base}, \ m(.) = \text{money multiplier}, \ B = \text{government budget surplus or deficit}, \ \Delta H = \text{change in the monetary base}, \text{and } \Delta D_G = \text{change in government debt}.
Parameters of interest are: $a = \text{average product of labor}$, $c_0 = \text{propensity to consume wealth}$, $c_1 = \text{propensity to consume of debtor households}$, $c_2 = \text{propensity to consume of creditor households}$,

Equations (A.1) and (A.2) determine the price level and real wage. These equations show how prices are related to nominal wages, the mark-up, and average productivity of labor.

Equation (A.3) is the goods market clearing condition which requires that output equal AD. Equation (A.4) is the aggregate production function in which labor is the only variable input. Equation (A.5) defines aggregate demand.

Equation (A.6) is the aggregate consumption function. This is a critical building block of the model, and aggregates the consumption of debtor and creditor households. The coefficient $c_0$ captures the propensity to spend out of real balances (the Pigou effect) and financial wealth. Because bank deposits are matched by bank loans, the Pigou effect is restricted to operating on the monetary base.

The coefficient $c_1$ captures debtor household’s propensity to spend out of income. The only source of income for these households is wage income, and it is reduced by the debt service payments they must make. These households receive a share, $\theta$, of the wage bill.

The coefficient $c_2$ captures creditor households’ propensity to spend out of income. These households receive income from five sources – wage income, debt service payments from debtor households, debt service payments from firms, that part of profits which firms to choose to distribute, and interest income on foreign assets. Firms do not distribute losses, and hence the Max condition attached to profit income.

The propensity to consume of creditor households is assumed to be less than that of debtor households, making debt service payments from debtor households to creditor households contractionary. This is a key element in the debt-driven business cycle model developed by Palley (1994, 1997), and it is a key factor in making deflation contractionary.

Equation (A.7) describes firms’ investment spending. Investment is negatively related to the interest rate, reflecting the cost of capital channel. It is positively related to output, reflecting an accelerator type effect. It is also positively related to cash flow, a finding for which there is robust empirical support (Fazzari et al., 1988). This is a critical channel, for cash flows are affected by firms’ debt service burdens. Lastly, investment is positively affected by asset values. This represents the balance sheet collateral effect emphasized by Bernanke at al. (1996).

Note that payment of dividends to creditor households has an ambiguous effect on AD. On one hand it increases the income of creditor households, which increases their consumption. On the other hand it reduces cash flows available to firms, which reduces investment spending. The net effect on AD depends on the relative size of the coefficients $c_2$ and $\alpha_3$. 
Equation (A.8) defines firms’ cash flows which are restricted to be the minimum of losses and retained profits. Firms’ profits are sales revenues minus the wage bill minus interest on domestic debt minus interest on foreign debt. If firms’ have net foreign asset holdings they receive foreign interest income.

Equations (A.9) and (A.10) determine export and import demands. Exports depend on the real exchange rate. Imports are a share of consumption spending, and that share depends positively on the real exchange rate.

Equations (A.11) and (A.12) describe the financial sector. Equation (A.11) determines the value of equities, which is equal to the discounted present value of profits. The coefficient $z$ is a coefficient of irrational exuberance. If $z > 1$, agents are irrationally exuberant; if $z < 1$ they are irrationally pessimistic. Equation (A.12) describes the money market equilibrium. The money supply is equal to the money multiplier times the monetary base. If the monetary authority controls the monetary base, the interest rate is endogenous. If it controls the interest rate, the monetary base is endogenous.

Finally, equation (A.13) describes the government budget constraint. The budget surplus or deficit must be financed by a combination of changes in the monetary base and government debt.

There are 13 equations. The endogenous variables are $P$, $W/P$, $Y$, $AD$, $N$, $C$, $I$, $CF$, $X$, $M$, $V$, $B$, $H$ or $i$.

**Appendix II: the super-neutrality of prices**

The model in Appendix I allows for price level effects on aggregate demand and equilibrium output. This addresses the neutrality of prices. The model is now augmented to allow for effects of steady sustained deflation of prices on aggregate demand and output. This addresses the super-neutrality of prices.

Steady deflation operates by changing agents’ spending decisions (IS effects) and portfolio demands (LM effects). IS effects are driven by inter-temporal substitution responses, which requires introducing inter-temporal relative prices as follows:

**Inter-temporal relative prices**

\[(B.1) \, P_{t+1} = [1 + \pi]P\]
\[(B.2) \, R = [1 + i]P/P_{t+1} = [1 + i]/[1 + \pi] \approx [1 + i - \pi] = [1 + r]\]

where $P_{t+1}$ = next period’s price level, and $R$ = relative price of goods today versus goods in the next period. Deflation ($\pi < 0$) causes the future price level to fall.

The relative price of consumption today is raised by the real interest rate which determines what is foregone by spending today. A higher real interest rate raises the
relative cost. Likewise, a nominal interest rate floor, which prevents the real interest rate from falling, also raises the relative price.

**IS effects**
The effect of deflation is to reduce the propensities to consume and invest. This is captured by re-specifying equations (A.6) and (A.7), the aggregate consumption and investment functions, as follows:

(A.6') \[ C = \left\{ c_0(R) \left[ H + V + D_G + D^*_H/e \right] + c_1(R) \left[ (1-t)WN - iD_w \right] \\
+ c_2(R) \left\{ [1-t] \text{Max}[0, \gamma (PY - WN - iD_F - i^*D^*_F/e)] \\
+ c_3(R) \left[ (1-t) \left[ \gamma WN + iD_w + iD_F + iD_G + i^*D^*_H/e \right] \right] \right\} / P \]

(A.7') \[ I = \alpha_0(R) + \alpha_1(R)(i - \pi) + \alpha_2(R)Y + \alpha_3(R)CF + \alpha_4(R)V \]

Now, the coefficients of the consumption and investment function depend negatively on the inter-temporal relative price of goods, R. A decrease in the future price level, brought about by deflation, induces a switch in spending away from the current period to next period.

Finally, in addition to the inter-temporal relative price effect, deflation also stands to induce a negative wealth effect. This is because deflation reduces the nominal value of future profits, which in turn lowers the current nominal value of firms’ equity. Thus, measured in today’s prices, households suffer a reduction in wealth.

**LM effects**
The portfolio demand effects of deflation can be captured by amending the money demand function to incorporate the impact of deflation as follows:

(A.12') \[ m(i)H/P = L(i, Y, \pi) \]

Deflation increases the demand for money since agents who hold money get a positive rate of return as the price level falls.
References


--------------, "Expectations, the Production Period, and Keynes' Aggregate Supply Schedule," The Manchester School of Economic and Social Studies, LXV (June 1997), 295-309.


<table>
<thead>
<tr>
<th>Price Deflation</th>
<th>Nominal Wages</th>
<th>Real Wages</th>
</tr>
</thead>
<tbody>
<tr>
<td>( P = (1+m)W/a )</td>
<td>( W )</td>
<td>( W/P = a/(1+m) )</td>
</tr>
<tr>
<td>Case (1): Pure deflation</td>
<td>Nominal wage deflation (-W)</td>
<td>Unchanged real wage</td>
</tr>
<tr>
<td>Case (2): New economy</td>
<td>Unchanged nominal wage</td>
<td>Real wage inflation (-m &amp; +a)</td>
</tr>
<tr>
<td>Case (3): Comprehensive deflation</td>
<td>Nominal wage deflation (-W)</td>
<td>Real wage deflation (+m or – a)</td>
</tr>
<tr>
<td>Case (4): Great Depression</td>
<td>Nominal wage deflation (-W)</td>
<td>Real wage inflation (-m &amp;/or + a)</td>
</tr>
</tbody>
</table>

**Price Inflation**

<table>
<thead>
<tr>
<th>Case (5)</th>
<th>Unchanged nominal wage</th>
<th>Real wage deflation (+m or –a)</th>
</tr>
</thead>
</table>

Table 1. Selected combinations of price, nominal wage, and real wage deflation. Deflation can co-exist with inflation.
### Table 2. Summary of the deflation transmission channel impact effects on AD under alternative configurations of deflation.

<table>
<thead>
<tr>
<th>Category</th>
<th>Case (1) – Pure Nominal Deflation</th>
<th>Case (5) – Real Wage Deflation</th>
<th>Case (2) – New Economy</th>
<th>Case (3) – Generalized Deflation</th>
<th>Case (4) – Great Depression</th>
</tr>
</thead>
<tbody>
<tr>
<td>Household sector:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Real wage/ wage share effects</td>
<td>0</td>
<td>- if wage-led</td>
<td>0</td>
<td>- if wage-led</td>
<td>+ if wage-led</td>
</tr>
<tr>
<td>2. Household debtor effect</td>
<td>-</td>
<td>0</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Household creditor effect</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>3. Household – real balance effect</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>- Equity value effect</td>
<td>-</td>
<td>+</td>
<td>?</td>
<td>?/+</td>
<td>?/-</td>
</tr>
<tr>
<td>4. Gov. deficit &amp; debt effect</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>5. Foreign asset &amp; income effect</td>
<td>- if debtor</td>
<td>+ if debtor</td>
<td>- if debtor</td>
<td>- if debtor</td>
<td>- if debtor</td>
</tr>
<tr>
<td>Firm sector:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Profit share effect</td>
<td>0</td>
<td>+ if profit-led</td>
<td>0</td>
<td>+ if profit-led</td>
<td>- if profit-led</td>
</tr>
<tr>
<td>7. Cash flow - domestic debt service</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>- foreign debt service</td>
<td>- if debtor</td>
<td>+ if debtor</td>
<td>- if debtor</td>
<td>- if debtor</td>
<td>- if debtor</td>
</tr>
<tr>
<td>8. Foreign sector - competition effect</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Financial sector:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Balance sheet collateral effect</td>
<td>-</td>
<td>+</td>
<td>?</td>
<td>?/+</td>
<td>?/-</td>
</tr>
<tr>
<td>9. Keynes money supply effect</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

The table above summarizes the impact effects on AD under alternative configurations of deflation.
Deflation

Asset bubble deflation

Generalized deflation

Exchange rate deflation

One time price level decline (neutrality)

Steady rate of price decline (super-neutrality)

Lower mark-up

Lower nominal wage

Higher productivity

Increased productivity growth

Nominal wage deflation

Figure 1. Taxonomy of deflation and its causes.
Figure 4. Shows the possibility of Alvin Hansen technology-induced unemployment. $a_1 > a_0$
<table>
<thead>
<tr>
<th>Nominal wage deflation</th>
<th>Profit-led: lower real wage = +</th>
<th>Wage-led: lower real wage = -</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>$\Delta \text{Output} = ?$</td>
<td>$\Delta \text{Output} = -$</td>
</tr>
<tr>
<td>+</td>
<td>$\Delta \text{Output} = +$</td>
<td>$\Delta \text{Output} = ?$</td>
</tr>
</tbody>
</table>

Figure 5. Shows how the direction of output response to comprehensive deflation depends on the nature of the economy’s response to nominal and real wage deflation.
<table>
<thead>
<tr>
<th>Nominal wage deflation</th>
<th>Profit-led: higher real wage = -</th>
<th>Wage-led: higher real wage = +</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal wage deflation = -</td>
<td>Δ Output = -</td>
<td>Δ Output = ?</td>
</tr>
<tr>
<td>Nominal wage deflation = +</td>
<td>Δ Output = ?</td>
<td>Δ Output = +</td>
</tr>
</tbody>
</table>

Figure 6. Shows how the direction of output response to nominal wage deflation and real wage increase (Great Depression) depends on the nature of the economy’s response to nominal and real wage deflation.
Figure 8.1. The pure portfolio effect of deflation with market determined nominal interest rates. $\pi_0 = 0$, $\pi_1 < 0$.

Figure 8.2. The pure portfolio effect of deflation with fixed nominal interest rates. $\pi_0 = 0$, $\pi_1 < 0$. 
Figure 8.3. The combined portfolio and inter-temporal substitution expenditure effects of deflation with market determined nominal interest rates. $\pi_0 = 0, \pi_1 < 0$.

Figure 8.4. The combined portfolio and inter-temporal substitution expenditure effects of deflation with a nominal interest rate floor. $\pi_0 = 0, \pi_1 < 0$. 
Figure 9.1. Case where the Pigou and Keynes effects dominate the Fisher debt effect, giving rise to positively sloped iso-AD contours. In this case downward nominal wage adjustment may be stabilizing or destabilizing. $AD_1 < AD_2$.

Figure 9.2. Case where Fisher debt effect dominates Pigou and Keynes effects, giving rise to negatively sloped iso-AD contours. In this case downward nominal wage adjustment is unambiguously destabilizing. $AD_1 > AD_2$. 
Figure 2. The impact of price, nominal wage, and real wage level reductions on real economic activity.
Figure 3. The deflation transmission mechanism.
Figure 7. Private sector transmission channel for exchange rate devaluation.