IRVING FISHER'S DEBT DEFLATION ANALYSIS: FROM THE PURCHASING POWER OF MONEY (1911) TO THE DEBT-DEFLATION THEORY OF THE GREAT DEPRESSION (1933)

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1. Introduction

Fisher introduced the 'debt-deflation theory of depression' for explaining the Great Depression of the early thirties. He first stated his theory in his book *Booms and Depression* (1932), summarized in the first volume of *Econometrica* (1933), taking the place of a presidential address to the *Econometric Society*. The fundamental idea of this new theory can be stated quite simply. Following a deflationary disturbance, the subsequent effect of a lower price level may not tend to bring immediately the level of output back toward its full employment value. The key point is that deflation gives a crucial role to borrower's balance sheet and net worth. Attempts to liquidate debt in the context of over-indebtedness and low price level are likely to turn into depression via an unstable interaction between excessive real debt burdens and deflation. Besides, deflation will come with price change effects – expectations of a falling price level – which may, by impacting negatively the expected profitability, reduce further the level of aggregate demand. It results as long as low price level do not affect positively and significantly aggregate demand and do not counteract the destabilizing price change effects, full employment equilibrium will not be restored.

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In the *Purchasing Power of Money*, when Fisher dealt with deflation, he was yet quite explicit about the distinction between price level effects and price change effects. Chapter IV, on 'Disturbance of equation [of exchange] and of Purchasing Power during Transition Periods', focused on the movements of real interest rates on economic variables, including aggregate production and employment. The central message was the following. Following a monetary disturbance, the subsequent change in the price level tends to change the nominal rate of interest and to bring the level of investment and global output back towards its long run equilibrium value. However, changing price causes also change in expected inflation and thus changes in real interest rate. Because adjustments of nominal interest rates to inflation can take a long time – what is confirmed in Fishers' subsequent articles in which the formation of inflation is modeled by distributed lags in actual inflation – full employment equilibrium may not be restored immediately.

Curiously, though, there has not been a systematic comparison between Fisher's 1933 debt deflation theory and the dynamic approach of the *Purchasing Power of Money* as regards the role that both explanations assigned to price level and price change effects. Dimand (2005, 2009) explored the concept of a corridor of stability in Fisher's works, showing how the wedge of the corridor depends on the relative importance of both price effects. The study however mainly focused on the debt-deflation process that Fisher expounded in 1933, mentioning only in passing Fisher's earlier work. The concern of the present paper is on the contrary to compare the role played by the price level and the price change effects in Fisher's 1911 and 1933 macro theories. We hence hope to better understand why, according to Fisher, the US economy recovered rapidly from the recession of 1920-21 but entered in severe depression after 1929.

It is argued in this paper that Tobin (1975, 1980) offered a macroeconomic model that can help identifying the main features of Fisher's 1911 and 1933 dynamic analysis. By indeed resorting to 1) the assumption that adjustments in the goods market occur through changes in quantity and price, 2) the natural rate hypothesis that output varies from potential output when expectations are mistaken and 3) the adaptative expectation hypothesis, Tobin built a simple reduced form general equilibrium model which capture central insights of Fisher 1911 and 1933 analysis[1].

Contributions to the real business cycle models (RBC) also provided components of a formal analysis of Fisher's debt deflation process. A significant fraction of the literature has focused on the impact of debt deflation on the change in the distribution of net wealth from debtors to creditors. Within RBC models with heterogeneous agents (see for example King 1994), it has been shown that debt deflation can lead to a fall in demand and output. More recently, several theoretical studies of debt deflation have focused on over borrowing and financial crises in an equilibrium model with collateral constraints. Using a dynamic stochastic general equilibrium model of asset prices and business cycles with credit frictions, Bianchi and Mendoza (2010) have provided a formal definition of overborrowing and determined how overborrowing was likely to affect business cycles and financial crises. In the model, the credit friction is in the form of a collateral constraint on debt. When this constraint does not bind, standard productivity shocks cause typical real business-cycle effects. When the constraint binds, the same shocks trigger Fisher's debt-deflation financial amplification mechanism, which can force "fire sales" of assets and cause a financial crisis.

By not focusing on the central Fisherian distinction between price level and price change effects, the recent equilibrium approach, though highly valuable for capturing some salient features of Fisher's debt deflation analysis, does not allow making a close comparison between Fisher's 1911 and 1933 analysis. That is why the present study will mainly refer to Tobin's disequilibrium approach which offers a more adequate framework for dealing with this issue.

The paper is organized as follows. The next section examines the dynamics that Fisher put forward in 1911 in the *Purchasing Power of Money*. The third section, by presenting Fisher's 1933 debt theory, discusses questions and modifications to Fisher's original theory. The fourth section investigates the stability properties of the 1911 and 1933 Fisher's models[2] and determine under which condition a debt-deflation process is likely to be globally destabilizing.

2. Fisher's 1911 analysis of deflation and depression

The first three chapters of the *Purchasing Power of Money* expound the quantity theory of money and conclude to the long-run neutrality of money. Fisher devoted two chapters on the merits and faults of existing price index to use in the equation of exchange and two

chapters on the empirical investigation of the quantity theory of money. In between these two groups of chapter, he offered in chapter IV, "Disturbance of Equation and of Purchasing Power during Transition periods", a theory of business cycle based on the movements of real interest rate on real economic variables, including aggregate production and employment.

Fisher was well aware that equilibrium analysis and comparative statics were not the best tools to deal with the macroeconomic effects of a change in the quantity of money. He knew that the phenomena he described are better regarded as disequilibrium dynamics: "Since periods of transitions are the rule and those of equilibrium the exception, the mechanism of exchange is almost always in a dynamic rather than a static condition" (Fisher 1911: 71). Fisher's dynamic model indeed produces a solution in which variables of the equation of exchange are not constant. Changes in these variables will in turn alter investment, saving, and other behaviors. For this reason, the solution of his model cannot be stationary and on this ground, it deserves to be qualified a disequilibrium process.

Fisher elaborated the equation of exchange $MV + M'V' = PT$ – where P is the price level and T is the physical volume per year – to incorporate the stock of money, M, and deposit currency, M', and their separate velocities, V and V'. The dynamics of the six elements in the quantitative equation during the transitory periods are the following:

1) The fall in prices – rise in the purchasing power of money – reduces the velocity of circulation (V and V'): the fall in price, due to holder's motive to hoard, leads to the fall in the volume of goods purchased. For a given quantity of money, this entails a fall in the nominal value of transaction PT. The resulting fall in aggregate demand in turn strengthens the deflation.
2) Fisher was quite clear that in the long run, real output and employment would not be affected by monetary shocks. He argued, in particular, that the long run equilibrium would depend ultimately on real factors, namely existing labor force and technology (Fisher 1911: 62). On the contrary, during transitions periods, trade T would be affected by movements in profit opportunities caused by changes in the cost of capital themselves entailed by the variations in the real interest rate. Fisher was indeed convinced that in the short-run, money would have real effects (Challe 2000: 17, Rebeyrol 1988: 114).

3) The fall in the price level – caused by the fall in aggregate demand resulting from the rise in the real rate of interest – urges borrowers to reduce their demand for loan. This reaction makes credit, and thus deposits currency M' to fall. The inevitable result is that demand for goods fall and prices fall further. This reveals that the multiplier $h = M/M'$ will not remained constant but will on the contrary strongly vary during the disequilibrium dynamics.

The core of Fisher's dynamic analysis lies in the connection between nominal interest rate, i, real interest rate, r, and inflation, π. Fisher used the equation $i = r + \pi$ as a long run condition of equilibrium. But for analyzing the disequilibrium dynamics, he replaced π by expected inflation, π^e. Because private debts in the unit of account are issued at a fixed rate of interest, changes in expected inflation necessarily impact the real rate of interest. It is only if the nominal interest rate could incorporate the future evolution of price that one would observed no change in the real rate of interest and no deviation of the economy from the steady state. The possibility of protracted depression is thus due eventually to incomplete adjustment of the nominal rate which remedy to disequilibrium very slowly if at all.

> The rate of interest in these cases [during depression] is agreed upon before the change in conditions takes place. There will, in consequence, be little if any adjustment in lowering nominal interest. Because interest is hard to pay, failures continue to occur. (Fisher 1911: 67-68)

It is worth reconsidering the previous analysis of the change in the six elements of the quantitative equation by referring to both the effects of the rate of change of nominal price and those of change in the level of the nominal price[3].

As for the price change effect, several mechanisms are at work. Fisher first asserts that a fall in the expected rate of inflation, despite the fall in nominal income occurring during the depression, increases the propensity to hold more money and deters consumption. With respect to this point, it is worth emphasizing that this argument departs clearly from the analysis based on what is usually called the Keynes effect. By assuming that the rate of interest could affect the willingness to hold money, Keynes went to conclude that a lower price level, by increasing the demand for bonds, was likely to reduce the rate of interest and

to stimulate investment and through the multiplier analysis, consumption and global income. While the Keynes effect compares high and low prices as dictated by the rules of comparative statics games whatever the evolution of expected inflation, Fisher's effect focuses on the process of change from high to low prices as dictated by the rules of dynamic games. In Fisher's framework, as soon as the expected rate of inflation is perfectly expected, the desire of agents to hold more money will vanish.

A decrease in the expected inflation rate, all things being equal, raises the real rate of interest and discourages investment. Contracts made when prices were higher and expected to remain higher remained in force. When prices start falling, the rise in financial burden thus entails unexpected losses: "*Among entrepreneur-borrowers's costs is interest*" (Fisher 1911: 59). As it would take time before such contracts are worked off, it is likely the losses will increase faster than prices will fall. Consequently, entrepreneur-borrowers will find themselves making lower profits than usual, and will be encouraged to contract their business and to revise their expectations[4].

Meanwhile, the repayment of bank loans will entail the contraction of the money supply during the deflation process without the monetary base having fallen. As Fisher indeed pointed it out in the chapters of the *Purchasing power of Money* devoted to dynamics:

> These borrowings are mostly in the form of short-time loans from banks; and, as we have seen, short-time loans engender deposits. As is well known, the correspondence between loans and deposits is remarkably exact. (Fisher 1911: 59)

Therefore, deposit currency (M') will decrease, but this contraction of deposit currency tends further to reduce the general level of prices. Hence the rate of interest, which was already outstripping prices, tends to outstrip it still further, inciting borrowers who were experiencing losses, to decrease them still further. Less loans are demanded, and although nominal interest may be reduced somewhat, the real rate of interest still remain above the normal level. Moreover, if prices are falling, the money value of collateral may be lower, making it more difficult for borrowers to get credit. Hence prices fall still further (Fisher 1911: 60).

As *for the price level effect*, the fall in the demand for loan entails eventually such a contraction of M' that nominal interest rate now decreases more rapidly than price and the real rate of interest starts decreasing.

> The contraction brought about by this cycle of causes becomes self-limiting as soon as the rate of interest overtakes the rate of fall in prices. After a time, normal conditions begin to return. The weakest producers have been forced out, or have at least been prevented from expanding their business by increases loans. The strongest firms are left to build up a new credit structure. (Fisher 1911, p. 69)

The turning point occurs here because the volume of inside debt is low. In that context indeed, after a relatively short period, all debts contracted earlier, eventually mature and are repaid or reconstructed. Alternatively, all new debts outstanding are contracted with foreknowledge of the new level of prices. In a context of over-indebtedness, Fisher suspected in his later works that this adjustment would be neutralized.

3. Fisher's 1933 debt-deflation theory

According to Fisher, most of the cycle theories of his time – including his dynamic analysis outlined in chapter IV of the *Purchasing power of money* (1911) – were believed to give only small grain of truth[5]. Fisher thought two dominating factors could eventually explain depression[6]: 'Over-indebtedness to start with and deflation following soon after', giving rise to two types of disease: 'the debt disease' and the 'dollar disease'. The combination of both diseases would end in a vicious circle responsible of strong and self-sustaining depression.

> I venture the opinion that, in the Great Booms and Depression, each above-named factor [over-production, under-consumption, over-capacity, price dislocation, over-confidence, over-investment…] has played a subordinate role as compared with two dominant factors, namely over-indebtedness to start with, and deflation following soon after […]. Disturbances in these two factors – debt and the purchasing power of the monetary unit – will set up serious disturbances in all, or nearly all, other economic variables. (Fisher 1933: 340-341)

Over-indebtedness may reveal destabilizing for two main reasons. First, attempts to liquidate debt in the context of over-indebtedness slow down the velocity of circulation and increase the incidence of bankruptcy, thereby reducing the level of aggregate demand and price. While a further round of attempts to repay debts causes additional declines in price.

> "The di-liquidation defeats itself […]. The very effort of individuals to lessen their burden of debts increases it; because of the mass effect of the stampede to liquidate in swelling each dollar owed […]. The more the debtor pay, the more they owe […]. Unless some counteracting cause comes along to prevent the fall in the price level, such a depression as that of the 1929-33 tends to continue, going deeper, in a vicious spiral, for many years. There is no tendency of the boat to stop tipping until it has capsized" (Fisher 1933: 344-346)

As bank loans are paid off, the volume of deposit currency is reduced (de Boyer 2003, Dimand 1994). If the effects on bankruptcy are strong enough, contraction of currency deposit coming with deflation will increase the real value of existing debt. If deflation is sufficiently strong, this can increase the real value of debt even if the volume of nominal debt has decreased, leading thus firms to continue their attempts to reduce their indebtedness.

The formal debt-deflation framework expounded in Chapters II and III of *Booms and Depressions* had nine factors in the sequence (Fisher, 1933: 342). 1) Debt liquidation, resulting from some monetary disturbances – Fisher leaves mainly unexplained the reasons for debt liquidation – urges borrowers to sell assets and to 2) a fall in the level of deposit as loans are repaid and to a slowing down of velocity of circulation', so that 3) asset and commodity prices drops, causing, given high level of inside debt with fixed nominal values, 4) a still greater increase in the real value of inside debt, precipitating bankruptcies. Losses occurred 5) so that firms curtail production and unemployment start increasing, 6) these losses lead to waves of bankruptcies and unemployment spread to the whole economy. This eventually causes 7) Pessimism and loss of confidence, which in turn lead to 8) hoarding and slow down still more the velocity of circulation. The interplay between real and nominal interest rates appear at the end of the sequence: nominal rates fell and real rates increases.

For comparing Fisher's 1911 depression analysis with his 1933 debt-deflation theory, it is worth clarifying the role played by the effects of the rate of change of nominal prices and those of change in the level of price in the latter analysis[7].

As for the price change effect, Fisher's view of the money supply is as much central in his 1933 debt's deflation analysis as in his 1911 disequilibrium analysis. Fisher indeed held to the view that the supply of deposit currency is essentially determined endogenously by the demand for loans. What changed concerned mainly the amount of inside debt and deposit. Given the huge level of inside debt existing at the eve of the Great depression, unanticipated price decline now start a scramble for liquidity that further deflates asset and commodity prices, reduces the money value of collateral and increases risk premia, making finally more difficult borrowers to get credit. The attempt to restore liquidity by selling assets to repay loans and to reestablish bank reserves is thus self-defeating, warned Fisher:

> By March, 1933, liquidation had reduced the debts about 20 per cent, but had increased the dollar about 75 per cent, so that the real debt, that is debt measured in terms of commodities, was increased about 40 per cent. (Fisher 1933: 346)

Fisher's analysis of the contraction of the money supply rests fundamentally upon the same argument expounded in Chapter IV of the *Purchasing Power of Money* with the difference that in 1911, because the level of inside debt is assumed to be lower, the effect of deflation on money supply eventually conducted the economy to full employment.

A*s for the price level effect*, it is noteworthy that Fisher's analysis no more trusts the contraction in deposit currency M' could entail eventually a fall in nominal interest rate capable, through reduction in real rate of interest, to restore full employment equilibrium. Due to the will of banks and of the public to hoard cash, Fisher even predicts the debt deflation process will continue while the monetary base increases as it happened in the US during the Great Depression. Furthermore, the positive effect of a lower price level will largely be offset by what Tobin (1980: 9-11) termed the Fisher effect of a change in the real value of inside debt. An unanticipated change in the level of price redistributes wealth to creditors from debtors, who presumably became debtors because of a higher marginal propensity to spend from wealth or other available resources. Since there is so much more

inside debt than outside money, even a small difference between debtors and creditors in marginal propensities to spend could lead this Fisher effect to swamp the positive effect of a lower price level. Moreover, given the level of outstanding nominal debt, the fear of costly bankruptcies may induce, as lower prices increase the real value of debt, a scramble for liquidity that would further reduce asset and commodity prices (Dimand 1994).

That is why Fisher urged measures – monetary expansion, devaluation, marking up gold prices – designed to restore commodity prices to pre depression levels:

> Those who imagine that Roosevelt's owed reflation is not the cause of our recovery but we had 'reached the bottom anyway' are very much mistaken. … If reflation can now so easily and quickly reverse the deadly down-swing of deflation after nearly four years, when it was gathering increased momentum, it would have been still easier, and at any time, to have stopped it earlier. In fact, under President Hoover, recovery was apparently well started by the Federal Reserve open-market purchases, which revived prices and business from May to September 1932. The efforts were not kept up and recovery was stopped by various circumstances, including the political 'campaign of fear'. (1933, pp. 346-347)

The salient features of Fisher debt-deflation analysis can be captured by Tobin's 1975 dynamic model. Because it addresses the issue of stability of full employment equilibrium, it is argued in the next section that Tobin's can help better understanding the main differences between Fisher's 1911 and 1933 approaches.

4. A Fisherian Model of price flexibility and output instability

Dimand (1994, 2005) had reconsidered the importance of Fisher's debt-deflation theory in the context of a three-equations disequilibrium model expounded by James Tobin (1975). Being based on Walras, Keynes and Phillips, Tobin named it W-K-P model.

Given the nominal stock of outside money, M, and other exogenous variables, desired real aggregate demand expenditure E is a function $E(p, x, Y)$ of three variables: p, the price level, x its expected rate of change, and Y the level of real income[8]. Let E_p and E_x denote the partial derivates of aggregate demand on the goods markets (under instantaneous

clearing of the money market), with respect to the price level p and expected inflation x[9] , and E_x represent the sum of the marginal propensity to consume and to invest[10].

The model consists of the following equations:

$$\dot{Y} = A_y[E(p, x, Y) - Y] \qquad (2.2.1.)$$

$$\dot{p} = A_p[Y - Y^*] + x \qquad (2.2.2.)$$

$$\dot{x} = A_x[\dot{p} - x] \qquad (2.2.3.)$$

Where Y is aggregate output, E is aggregate demand (consumption plus investment), x, expected rate of inflation, $\dot{p}$, current inflation, Y^*, natural output, and A_y, A_p and A_x are respectively the positive speed of adjustment of output, prices and expected inflation.

The Walrassian aspect of Tobin's W-K-P is equation (2.1.1.) assuming that quantity adjusts to the difference between aggregate demand and aggregate supply at existing price (Tobin 1975: 196) and not along Marshallian lines according to which quantity adjusts to the difference between demand price and supply price for existing quantity.

Equation (2.2.2.) is a natural-rate version of the Phillips curve showing output varies from potential output Y^*only when expectations are mistaken. Tobin condensed the product and labour markets into one sector so that excess labor supply and the gap $Y - Y^*$are linked. When one is zero so is the other.

Equation (2.2.3) assumes that expectations are formed in the adaptative way. If the actual rate of inflation exceeds the expected rate, then expectations are revised to increase the expected rate.

Tobin's model captures central features of Fisher's macroeconomics (Dimand 1994, 2005). Fisher's demonstration of long-run money neutrality rest indeed upon the idea that when inflation is correctly expected, Y^* is independent of the inflation rate. The 'Phillips curve' linking the output gap to unexpected inflation also recalls the correlation between output and a distributed lag of price changes developed by Fisher (1923, 1925) (see Dimand 1994). Moreover, "the adaptative expectations hypothesis of equation (2.2.3) matches Fisher's practice, when decomposing the money interest rate into real interest and expected

inflation, of representing expectations by a distributed lag of past price changes. (Dimand 2005: 192).

The system of three differential equations determines the time path of Y , p and x , given the initial conditions. Substituting the equation $\dot{p} = A_p[Y - Y^*] + x$ into the equation $\dot{x} = A_x[\dot{p} - x]$ we obtain $\dot{x} = A_x A_p[Y - Y^*]$. Linearizing these three equations about the equilibrium point, we obtain[11]:

$$\begin{pmatrix} \dot{Y} \\ \dot{p} \\ \dot{x} \end{pmatrix} = \begin{pmatrix} A_Y(E_Y - 1) & A_Y E_p & -A_Y E_r \\ A_p p^* & 0 & p* \\ A_x A_p & 0 & 0 \end{pmatrix} \begin{pmatrix} Y \dot{-} Y^* \\ p - p^* \\ x \end{pmatrix}$$

The equilibrium values of Y , p and x, are obtained by setting $\dot{Y} = p = \dot{x} = 0$. Note that at equilibrium, we have full employment and price stability ($Y = Y^*$ and $\dot{p} = x$). To derive the stability conditions, we derive the characteristic equation of the coefficient matrix. This can be written as :

$$det(M_J - \lambda I) = (-1)^3\left[\lambda^3 - A_Y(E_Y - 1)\lambda^2 - A_Y A_p\left(E_p p^* + E_x A_x\right)\lambda - A_x A_x A_p E_P p^*\right] = 0$$

or

$$\lambda^3 + a_1\lambda^2 + a_2\lambda + a_3$$

Where, $a_0 = 1$, $a_1 = -A_Y(E_Y - 1)$, $a_2 = -A_Y A_p\left(E_p p^* + E_x A_x\right)$, $a_3 = -A_Y A_x A_p E_p p^*$. The Routh-Hurwitz condition for stability is written as $a_0 > 0$, $a_1 > 0$, $a_2 > 0$, $a_3 > 0$, $a_1 a_2 - a_3 > 0$. $a_1 > 0$ and $a_3 > 0$ are satisfied by $E_Y < 1$ and $E_p < 0$. The remaining condition, $a_1 a_2 - a_3 > 0$, can be written as[12]:

$$E_p p^* + E_x A_x < -\frac{E_p p^* A_x}{A_Y(E_Y - 1)} < 0.$$

Inspection of this condition reveals that the greater is A_Y, the speed of adjustment of output, the smaller is E_Y, the sum of the marginal propensity to spend and to invest, the weaker is E_x, the price expectation effect, and the lower is the response of price expectations to experience, A_x, the more likely is the equilibrium stable. The effect of E_P on stability is however ambiguous. A strong negative price-level effect on aggregate demand renders the system stable only if

$$\frac{A_x}{A_y(1-E_Y)} < 1$$

Let's us now consider how Tobin's W-K-P model allows exploring the stability of full employment equilibrium in both Fisher's 1911 and 1933 analysis. In the dynamic part of the *Purchasing Power of Money*, the price level effect expounded by Fisher will tend to make the term $E_p p^*$ positive for small deviation from equilibrium but negative at low values of Y and p with the result that the stability condition might not be satisfied once a shock had slightly displaced Y from Y^* but valid when Y diverge significantly from Y^*. Recall Fisher's argument. The contraction of demand for loan entails eventually such a contraction of deposit currency that nominal interest rate eventually decreases more rapidly than price. Formally, this means, depending on the extent of the output gap, the coefficient E_p is likely to change sign: E_p being respectively positive and negative for small and large deviation of Y. Obviously, the less is the volume of outstanding nominal debt, the more rapidly E_p becomes positive.

The price change effect expounded by Fisher in 1911 would tend to make the term $E_x A_x$ positive. A decrease in the expected inflation rate raises the real rate of interest. This discourages investment, and deters consumption due to higher hoarding. Again, the force of the price expectation effect is related to the volume of outstanding inside-debt. The higher is the volume of inside-debt, the more important will be deflation. It thus results that the system is likely to be more unstable for small deviations from the equilibrium and more stable as the price change effect, due to decrease in the volume of inside debt, becomes lower.

Fisher's (1911) analysis is devoid of a formal model of the determination of real output and employment which explain in a precise way how aggregate demand and aggregate supply adjust. One indeed struggled for isolating insights clarifying the role played by the marginal propensity to consume and to invest. It is thus hard to conclude, on the basis of Fisher's 1911 argument, about the role of the coefficient E_Y. For the W-K-P model, the maximum value of the marginal propensity to spend is less than one, which means that the propensity to save must necessarily be higher than the propensity to invest, a proposition that Fisher would certainly have accepted.

It is also interesting to observe that the smaller is the quantity adjustment coefficient A_Y, the more unstable is the economy. Again, it is difficult with regard to Fisher's development to discuss the value he would have attributed to this coefficient.

Let us now deal with Fisher's 1933 analysis. As regards the effect of an unanticipated low level of price, Fisher concludes wealth will be redistributed between creditors and debtors. Because of a higher marginal propensity to spend from wealth of debtors, the positive effects of the increased real value of creditor's nominal assets may well be overshadowed, so that aggregate demand will fall. Well, if there is so much more inside debt than outside money, contraction of aggregate demand may be important. Fisher (1932, 1933) also argued that, when nominal prices are deflated, debt service is a higher proportion of debtor's incomes while the rise in its debt/equity ratios disqualifies borrowers from further access to credit. Because of the increase in the incidence of bankruptcy, distress of debtors is transmitted to their creditors, which eventually threatens the solvency and liquidity of individual lenders and financial institutions. Given the level of outstanding nominal debt, the fear of costly bankruptcies, induced as falling prices increase the real value of debt, can thus cause a scramble for liquidity that can further reduces asset and commodity prices (Dimand 1994). At the end of the day, the individually rational scramble for liquidity by debtors can end up increasing their real burden of debt in aggregate (Dimand 2005).

The redistribution of wealth as the value of inside debt changes tends to make E_p positive with the result that the stability condition might not be satisfied. As a consequence, If E_p never becomes negative, the equilibrium is likely to be globally unstable. Here lies certainly the main difference between Fisher's 1911 analysis and his 1933 analysis. While, in the *Purchasing Power of Monney,* E_p becomes negative once Y is far below Y^*, due to huge amount of inside debt, along Fisher 's 1933 analysis, one must admit E_p will remain positive whatever the importance of the monetary disturbance. In other words, the stabilizing effect expounded in 1911 according to which a lower price level will tend to contract inside money M' and to let the real rate of interest to fall is no more effective.

It is worth here noting that even if expectation of inflation did not respond at all to experience ($A_x = 0$) and the term $E_x A_x$ of the stability condition vanishes, as long as E_p is positive, the system will continue diverging from the stationary equilibrium. Moreover, even

if investment is assumed to not depend on the real interest rate, then $E_x = 0$, the model would be unstable whatever the size of the other functional relations.

5. Summary and some suggestions

This paper has tried to clarify the role played by the price level and price change effect in Fisher's 1911 and 1933 monetary analysis. We have shown that both studies deal with financial factors which are central and adopt a disequilibrium approach. The formal analysis based on Tobin's 1975 disequilibrium model has shown that Fisher's argument has an analytical foundation related to the stability properties of the stationary equilibrium. While the 1911 analysis concludes to the local instability of the equilibrium, the 1933 argument concludes to its global instability.

It would be interesting to extent Fisher's approach to situation in which the expectation effect would be likely to vary. Along Fisherian arguments, the approach might in particular deal with such questions as the effect of changing expectation elasticity in relation with the state of confidence. The study might hence shed light on the role of the central bank in fight against deflation through anchoring of price expectations and the way it is likely to influence expectations. In the same vein, it would be worthwhile to amend Tobin's model for focusing on bank behavior. In Tobin's model indeed, banks play a passive role while changes in the cost of financial intermediation that have proved to matter much during the Great depression are not taken into account. One could hence be able to precise how these financial factors are likely to impact the stability parameters of the system.

Finally, it would be interesting to investigate the stability properties of Fisher model by assuming markets adjust along Marshallian lines, according to which quantity adjusts to the difference between demand price and supply price for existing quantity and no more along Walrassian lines.

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Abstract

In 1933, Irving Fisher suggested an explanation of the Great Depression based on the distinction between price level and price change effect of deflation in a context of over-indebtedness. This paper aims at comparing Fisher's 1933 debt-deflation theory to the dynamic depression process Fisher expounded in almost twenty years earlier in the *Purchasing Power of Money* (1911). The role played by both price level and price change effects in Fisher's 1933 and 1911 analysis are clarified in the context of Tobin (1975) disequilibrium model. More precisely, it is shown, with regard to Fisher's insights, that the stationary equilibrium is assumed to be locally unstable in 1911 and globally unstable in 1933.

Key words

Debt-deflation, depression, Fisher, price level effect, price change effect, Tobin.

[1] Tobin's model provoked lively exchanges on the role of price level and the rate of change of prices in different types of disequilibrium dynamics (Howitt 1978, Tobin 1993, Groth 1993, Flaschel and Franke 2000, Dimand 2005).

[2] It is worth here recalling that Fisher did not provide a formal model of his 1911 and 1933 monetary macroeconomics theory. As regards his latter-day macro theory, Tobin also noticed: "The point here is that he [Fisher] came to recognize important non-monetary sources of disturbance. These insights contain the makings of a theory of a determination of economic activity, prices, and interest rates in short and medium runs. Moreover, in his neoclassical writings on capital and interest rate Fisher had laid the basis for the investment and saving equations central to modern macroeconomic models. Had Fisher pulled these strands together into a coherent theory, he could have been an American Keynes. Indeed the 'neoclassical synthesis' would not have had to wait until after World War II. Fisher would have done it all himself." (Fisher 1987: 374)

[3] Fisher was well aware of the importance the distinction between these two effects. Fisher indeed insisted that: « The transition periods may be characterized either by rising prices or by falling prices. Rising prices must be clearly distinguished from high prices, and falling from low. With stationary levels, high or low, we have in this chapter nothing to do. Our concern is with rising or falling prices. Rising prices mark the transition between a low and a high level of prices, just as a hill marks the transition between flat lowlands and flat highlands" (Fisher 1911: 56)

[4] Fisher assumed that expectations are imperfect and adjust progressively. The argument is based on an asymmetry between borrower and lender, the former being less victim of money illusion than the latter (Fisher 1911: 68).

[5] "The old and apparently still persistent notion of "the" business cycle, as a single, simple, self-generating cycle (analogous to that of a pendulum swinging under influence of the single force of gravity) and as actually realized historically in regularly recurring crises, is a myth. Instead of one force there are many forces. Specifically, instead of one cycle, there are

many co-existing cycles, constantly aggravating or neutralizing each other, as well as co-existing with many non-cyclical forces." (Fisher 1933: 49)

[6] Over-investment and over-speculation matter when carried on with borrowed money.

[7] Fisher's 1933 analysis is explicitly dynamic. As Fisher emphasized it, the good ground for dealing with deflation and depression is the disequilibrium analysis and not comparative statics.

> The economic system contains innumerable variables – quantities of 'goods', the prices of these goods, and their values. […] Only in imagination can all of these variables remain constant can be kept in equilibrium […]" (Fisher 1933: 337).

[8] In finer detail, E results from the solution of the IS-LM system (see Takayama 1994).

$$Y = E(Y, i - x)$$

$$M/P = L(Y, i)$$

Where Y is aggregate output, E is aggregate demand (consumption plus investment), i, the nominal rate of interest, x, expected rate of inflation, M, outside money, p, price level, L, money demand, and $i - x$, the real rate of interest. The model approaches Tobin's (1975) models if one assumes, in contrast to the goods market, that the money market adjusts very quickly by the fluctuations of interest rate and that the condition $M/P = L(Y, i)$ always hold. Solving this equation for i_r, we obtain $i = i(Y, p, M)$. Using this we may indeed define the function $E = E(Y, i(Y, p, M) - x)$.

[9] Tobin speaks of price-level and price-change effects, respectively.

[10]Since $M/P = L(Y, i)$, we get $d(M/p) = L_i di + L_Y dY$. For constant M and p, we have $i'_Y = di/dY = -L_Y/L_i > 0$, $i'_p = -M/p^2 L_i > 0$. Derivation of the function $E(Y, p, x)$ yields:

$E_Y = dE/dY = E_Y + E_i r'_Y = E_Y - E_i L_Y/L_i$, $E_x = dE/dx = -E_i$ and $E_p = dE/dp = -E_i\, M/PL_i$.

[11] The derivation of the stability condition of Tobin's 1975 model is given by Bruno and and Dimand (2009).

[12] As shown by McDonald (1980), this condition is more restrictive than the condition given by Tobin (1975: 199). Tobin's condition is $E_p p* + E_x A_x < 0$, which, while sufficient to ensure that $a_2 > 0$, is not sufficient to ensure that $a_1 a_2 - a_3 > 0$, and thus not sufficient for stability.