

# CENTRE FOR APPLIED MACROECONOMIC ANALYSIS

The Australian National University



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**CAMA Working Paper Series**

**March, 2009**

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BEHAVIOURAL MACROECONOMICS AND WAGE AND PRICE  
SETTING: DEVELOPING SOME EARLY INSIGHTS OF JOHN  
MAYNARD KEYNES AND JOAN ROBINSON

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CAMA Working Paper 11/2009  
<http://cama.anu.edu.au>

23/8/2008

**Behavioural macroeconomics and wage and price setting: Developing some early insights of John Maynard Keynes and Joan Robinson (with appendix B)**

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**Abstract**

This paper argues that the theory of wage and price setting in macroeconomics should be broadened to include insights from behavioural economics, in particular prospect theory and loss aversion. The paper shows how broader microeconomic foundations can explain the main features of a realistic Phillips curve, which are the concurrence of a steep SRPC at low unemployment, a flat SRPC at high unemployment and speed-limit effects. The resulting macroeconomic model has the benefits of consistency with important properties of natural rate models, especially a crucial role for inflation expectations and, in determining the economy's macroeconomic potential, for supply factors, plus the benefit of consistency with the standard IS/LM model. The paper also shows that the behavioural aspects of these broader microeconomic foundations were alluded to by Keynes and Robinson in 1936 when macroeconomics was created.

**Keywords: unemployment, inflation, behavioural economics**

**JEL codes: E12, E24, E31**

## **Behavioural macroeconomics and wage and price setting: Developing some early insights of John Maynard Keynes and Joan Robinson**

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“in response to an initiating cause of disturbance, (prices) seem to be able to find a level at which they can remain, for the time being, moderately stable”, Keynes (1936, p.250).

“the economist must wait for the development of a science of social psychology to supplement his own methods of analysis”, Robinson (1937, p.172)

### **1 Introduction**

Recently, prominent mainstream economists have argued that at the current time macroeconomic practice and macroeconomic research are disconnected, see Krugman (2000) and Mankiw (2006). Krugman argues that macroeconomic practice, especially in policy formulation, is guided by models based on the IS-LM approach. However, the bulk of macroeconomic research eschews the IS-LM approach and instead uses variants of the natural rate of unemployment approach, in either New Keynesian theory or real business cycle theory.<sup>1</sup> Reflecting on this disconnect, Mankiw (2006) entertains the possibility that macroeconomics since 1968 has taken the wrong turn.<sup>2</sup>

One of the faults that Krugman (2000) finds in current macroeconomic research is a failure to model price stickiness satisfactorily. Krugman criticises the plausibility of real business cycle theory because of its excessive flexibility in prices.

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\* I thank Bob Solow for helpful comments.

<sup>1</sup> Mankiw quotes Laurence Meyer’s memoir which shows that these new developments “have had close to zero impact on practical policymaking”, Mankiw (2006, p.40). Central banks, whilst having moved in the direction of independence, are not rule-bound, but exercise discretion. Furthermore, the economic record while Alan Greenspan headed the Federal Reserve shows that discretion is consistent with low and stable inflation, counter to the Kydland and Prescott (1977) conclusion. The policy of tax cuts in 2003 was explained by President Bush using “quintessentially Keynesian”, that is IS-LM, analysis and its economic impact was analysed using an IS-LM based econometric model.

<sup>2</sup> However, Mankiw concludes that the road taken is not the wrong road, just a very long road which will eventually lead to an integration of theory and practice.

On the other hand, he argues that the price stickiness in New Keynesian theory, based on menu costs and time-dependent contract lengths, is too simplistic to capture important subtleties in the real world. In particular, Krugman argues that the price stickiness in New Keynesian theory lacks useful predictions about when prices are sticky and when they are not. Krugman (2000, p.39) concludes that “models that build from menu costs to a realistic Phillips curve, just don’t seem to be forthcoming”. Mankiw (2006) agrees with these criticisms of Krugman. Gosolov and Lucas (2007) make a related criticism of the New Keynesian pricing model, emphasising the weakness of pricing decisions being modelled as time dependent rather than state dependent.<sup>3</sup>

The model of McDonald and Sibly (2005), called here the prospect-bargaining model, offers a way forward from the criticism of macroeconomic practice and macroeconomic research being disconnected. This model has microeconomic foundations, the *sin qua non* of macroeconomic research, and yet can support the fundamental Keynesian proposition which IS-LM analysis is designed to represent, that changes in nominal aggregate demand can have real effects through a direct effect on sales rather than through a divergence between expected and actual prices. In the prospect-bargaining model the short-run Phillips curve (SRPC) is steep at low rates of unemployment and flat or horizontal at high rates of unemployment. It is the latter flatness that gives the model its Keynesian/IS-LM potential.

The prospect-bargaining model is able to explain a pattern of wage and price behaviour that supports Keynesian properties through its use of ideas from behavioural economics, especially prospect theory and loss aversion, in its microeconomic foundations. It also makes use of bargaining theory and customer market theory.<sup>4</sup>

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<sup>3</sup> In their reformulation of the New-Keynesian price setting process to relax the time-dependent assumption Gosolov and Lucas (2007) find, in keeping with the earlier work in Caplin and Spulber (1987), that aggregate shocks have very small real effects, which is inconsistent with the large real effects of monetary instability.

<sup>4</sup> Using ideas from behavioural economics, Akerlof, Dickens and Perry (1996), (2000) have put forward two models of nominal wage stickiness. Although the prospect-bargaining model as presented in this paper can generate Keynesian behaviour without the assumption of money illusion, it may be that there is something special about resistance to money wage cuts that influences aggregate outcomes. Fehr and Tyran (2001) present experimental evidence that supports the idea that people exhibit money illusion when there is coordination failure. However, note that even money wages are cut on occasion, as in the 1930s. As will be seen, the prospect-bargaining model as extended in this paper, whilst determining real wages, also offers an explanation of when nominal wages are rigid and when they are cut that is consistent with the experience in the 1930s.

However, the prospect-bargaining model as set out in McDonald and Sibly (2005) has excessive stickiness in wages and prices at high unemployment and so does not explain when prices are sticky and when they are not. In particular, the model misses an important aspect of a realistic Phillips curve; that is the common observation of a speed-limit effect, which is an inverse relation between the change in the unemployment rate and the rate of inflation. Lacking this subtlety of wage and price stickiness in the real world, the model is perhaps open to Krugman's critique noted above.<sup>5</sup> The main aim of this paper is to show how that the prospect-bargaining model can be extended to yield the more subtle and realistic pattern of wage and price adjustment captured by the combination of a speed-limit effect with a flat SRPC. Thus the extended model explains a pattern where wages and prices are sticky but that stickiness can be overridden, temporarily, by changes in activity. This combination will also be described in this paper by the short-hand term, 'flex-fix price pattern'.

An inflation-unemployment relation that combines a steep SRPC at low unemployment, a flat SRPC at high unemployment and speed-limit effects, is consistent with empirical work. Estimates of the Phillips curve that allow for a convex relation reveal a very flat SRPC at high rates of unemployment, see eg Phillips (1958) and Debelle and Laxton (1997). Estimates that allow for a piecewise-linear SRPC reveal a flat section of the SRPC, see Barnes and Olivei (2003), Driscoll and Holden (2004), Lye, McDonald and Sibly (2001) and Lye and McDonald (2006), (2008). As representative of the findings in these papers, the SRPCs for Australia and the US as estimated by Lye and McDonald (2008), (2006) are shown in Figure 1.<sup>6</sup> The estimates in Lye, McDonald and Sibly (2001) and Lye and McDonald (2006), (2008) for Australia and the US also allow for speed limit effects. For the US in particular, the estimates suggest that speed limit effects are substantial.<sup>7</sup>

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<sup>5</sup> It is not clear from Krugman's exposition whether this pattern of when prices are sticky and when they are not is precisely the one he had in mind.

<sup>6</sup> For the US, the flat section is 1.3 percentage points of unemployment with a further region at higher rates of unemployment where the SRPC is very flat, compared with its steepness at low rates of unemployment. This flatness over the two sections of high unemployment suggests that the deceleration hypothesis doesn't hold or at least is very weak. For Australia, the estimates imply that over the period of estimation, that is since the mid-1960s, there has been no sign of an upper limit to the flat section of the SRPC.

<sup>7</sup> For Australia, during the period when inflation and unemployment outcomes were on the flat part of the SRPC, that is from 1980:2 to 2003:3, the estimate of the speed-limit effect is not significant. However, for the two major recessions within that period, in the early 1980s and early 1990s, there were substantial speed-limit effects.

At the outset of the Keynesian revolution, John Maynard Keynes (1936) and his disciple, Joan Robinson (1937) also observed this relation between inflation and unemployment.<sup>8</sup> In their view, at high rates of unemployment, inflation was not persistently decreasing.<sup>9</sup> A negative shock to aggregate demand, at high rates of unemployment, tends to cause wages and prices to fall but the fall will be temporary. Wages and prices will settle at a new level, even although the rate of unemployment has increased. Thus, using modern terminology, they saw a flat SRPC combined with speed-limit effects, or, in the terminology of this paper, a flex-fix price pattern.<sup>10</sup> This pattern they argued vigorously rendered the classical approach, in which in their words wages and prices can ‘fall without limit’, deeply flawed.

By contrast, at low rates of unemployment Keynes and Robinson expressed strongly the view that inflation would be increasing, forced up by excess demand. In modern terminology, they viewed inflation as following, at low rates of unemployment, the accelerationist hypothesis.<sup>11</sup>

The second aim of the paper is to show that the behavioural factors in the prospect-bargaining model can be linked to the discussion of Keynes (1936) and Robinson (1937) of the determination of the flex-fix pattern of wages and prices.<sup>12</sup> In their discussion of causes, both Keynes and Robinson referred to ideas they described

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<sup>8</sup> Their observations are documented in Appendix B.

<sup>9</sup> The point defining the boundary between low and high unemployment was called full employment by Keynes and defined by Keynes in classical terms, as where the marginal disutility of work equalled the marginal product of work. Robinson questioned the relevance of this definition and suggested that trade union bargaining power would cause the boundary point to differ from full employment.

<sup>10</sup> A similar pattern, that is, at high rates of unemployment, flex followed by fix, is shown for the 1930s for all countries for which data is reported in Maddison (1991), see McDonald (1995), a chapter in Cross (1995). This pattern is not restricted to the 1930s. For example, there is a similar pattern in Australia, Germany, UK and US in response to the recession of the early 1980s, see McDonald (1995). For those economies, inflation initially fell as unemployment rose but this fall stopped while unemployment remained high. In his review of Cross (1995), Richard Lipsey describes this evidence as documenting “the major scandal which was apparent from the outset of NR [=natural rate] theorising: the failure of inflation to decelerate continually during periods of persistent high unemployment”, Lipsey (1997, p.209).

<sup>11</sup> Thus neither Keynes nor Robinson, in 1936, disputed, using modern terminology, the accelerationist hypothesis. Indeed Robinson spelled out an acceleration process in which the adjustment of expectations played a crucial role and thus preceded the work of Friedman (1968) and Phelps (1968). What Keynes and Robinson did dispute was its symmetric converse, the decelerationist hypothesis, that is the tendency for inflation to be decreasing at high rates of unemployment

<sup>12</sup> The Robinson essays are relevant because of the close connection between Robinson and Keynes. Robinson was involved with the development of the General Theory and read and gave comments to Keynes on various drafts of the General Theory and the page proofs. Her essays “represent an attempt to apply the principles of (the General Theory) to a number of particular problems”, Robinson (1937, p.v). In a reissue of these essays in 1973, Robinson says “Keynes himself approved them and accepted amendments that they suggest in some formulations in the General Theory”, Robinson (1973, Foreword, p.v).

as psychological. Whilst these ideas have not played an important role in the subsequent macroeconomic literature, today they have gained importance in economics more generally with the rise of behavioural economics. Keynes and Robinson both expressed the view that, as of 1936 the science of social psychology was insufficiently developed to provide a systematic analysis of the determination of prices and wages. However, the theory of economic psychology has developed considerably since they expressed these views, especially for our purposes with the prospect theory of Kahneman and Tversky (1979).

Keynes and Robinson also discussed the influence on wages of bargaining outcomes between workers and employers. Robinson, but not Keynes, expressed scepticism about the theoretical soundness of bargaining theory. But, again, since 1936 there have been considerable developments in bargaining theory and its application to wage determination, for example McDonald and Solow (1981).

The prospect-bargaining model also draws on customer market analysis. Whilst comments consistent with customer market analysis were not apparent in their 1936 contributions, in later work, Robinson (1962, pp.73-4) referred to a variability to price-marginal cost mark-ups.<sup>13</sup> This variability is inconsistent with the standard economic model of pricing but is consistent with customer market analysis, an area that has grown since the work of Scitovsky (1952). Joseph Stiglitz (1979) and Arthur Okun (1981) emphasised the Keynesian macroeconomic implications of customer market analysis.<sup>14</sup> Subsequently models of a range of equilibrium rates of unemployment were derived from customer market analysis by Woglom (1982), Kling (1982) and McDonald (1987).<sup>15</sup>

To provide a direct explanation of a speed-limit effect in money wages, in this paper a fixed cost of production is incorporated into the prospect-bargaining model. With a fixed cost, contractions will put pressure on factor incomes. If wages remain

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<sup>13</sup> In analysing the effects on prices of falling costs, Robinson argues that “At some point the stickiness of prices breaks down in one market after another, and a burst of competition brings profit margins down with a run” Robinson (1962, p.73). This is not inconsistent with customer market analysis, in that in customer market analysis the force of competition determines the upper limit of the price-marginal cost margin. At prices exceeding this upper limit, competition breaks out.

<sup>14</sup> Okun’s description of customer markets, Okun (1981, pp.138-55) is mainly based on the Scitovsky information asymmetry. However, he also brings in fairness considerations, for example when arguing that firms are more likely to increase prices following increases in costs than following increases in demand. Kahneman, Knetsch, and Thaler (1986) use Okun’s analysis of customer markets to introduce their analysis of fairness.

<sup>15</sup> More recently, Akerlof (2007, pp.26-7) has discussed how customer markets can generate behaviour inconsistent with the natural rate model. Akerlof emphasises the possibility of a long-run trade-off between inflation and unemployment rather than a horizontal SRPC.

fixed, then profits would be severely squeezed, perhaps forced into losses. To relieve this pressure, the fixity of wages, in being tied through loss aversion to the reference wage, is overridden and wages are reduced.

Introducing the possibility of squeezes on factor incomes into the prospect-bargaining model is motivated by empirical evidence that downward wage flexibility is caused by the desire to prevent a firm or plant being driven out of business. Henle (1973) showed this. More recently, Truman Bewley's interviews with managers of firms and labour leaders has revealed that workers will accept wage cuts if that relieves pressure to close down the firm or plant and so saves their jobs, see Bewley (1999, pp. 173, 181, 376, 380 and 395).<sup>16</sup> Akerlof, Dickens and Perry (1996) reinforce Bewley's findings with additional evidence from Bureau of Labor Statistics data, and conclude that "downward rigidity is broken when firms are under extreme duress", Akerlof, Dickens and Perry (1996, p.9).<sup>17</sup>

The prospect-bargaining model embodies two important characteristics of natural rate analysis. First, in the prospect-bargaining model the expected rate of inflation influences the actual rate of inflation. An implication of having this characteristic is that the prospect bargaining model can match the explanation offered by the natural rate model of the stagflation of the 1970s, a valuable characteristic of the natural rate model, as emphasised by Krugman (2000), but without incurring the cost of sacrificing a Keynesian theory of aggregate demand. Second, the boundary point between low and high unemployment, which is the point that separates the region of classical flex price behaviour from the region of a flex-fix price pattern, is determined by the same supply factors posited by Friedman (1968) and Phelps (1972) to influence the natural rate. This boundary point is called  $u^{\min}$  in the prospect-bargaining model because it is the lowest rate of unemployment consistent with non-increasing inflation. In the prospect-bargaining model,  $u^{\min}$  is the conceptual equivalent to the natural rate of unemployment in the classical model.<sup>18</sup>

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<sup>16</sup> Bewley's interviews reveal additional empirical support for the prospect-bargaining model in supporting a Keynesian view, see especially Bewley (1999, pp. 17, 153, 220, 221, 329 and 344), and the importance of loss aversion, see especially Bewley (1999, pp. 111, 134, 175, 176, 196, 431, and 432). However, the prospect-bargaining model of this paper requires further development to include explicitly Bewley's emphasis on the importance of morale for labour productivity.

<sup>17</sup> In their simulation model, Akerlof, Dickens and Perry (1996) allow low profitability to reduce nominal wages but do not use a model of individual decision-making to support this relation.

<sup>18</sup> The estimates of the Phillips curve implied by the prospect-bargaining model for Australia and the US in Lye, McDonald and Sibly (2001) and Lye and McDonald (2006), (2008) show that  $u^{\min}$  is significantly influenced by supply factors, especially unemployment benefits and, for Australia, trade

In relation to the criticisms of Krugman and Mankiw noted above, this paper proposes that the right road for modelling the setting of wages and prices in macroeconomics is one with broader microfoundations that include insights from behavioural economics and prospect theory, in particular the importance of reference dependence and loss aversion. The neglect of behavioural foundations for wage and price setting in macroeconomics, a neglect that is very marked since 1968, is an example of macroeconomics following what Bruni and Sugden (2007) have called the Paretian turn, a turn which they regard as a fundamental mistake in economics. The road suggested in this paper, by using behavioural foundations, is consistent with the direction advocated by Bruni and Sugden (2007).

Section 2 of the paper describes the views of Keynes and Robinson on the role of ideas from prospect theory and bargaining theory in explaining the flex-fix pattern of wage and price behaviour at high rates of unemployment. In section 3 the prospect-bargaining model of unemployment and inflation is shown to imply a flat section for the SRPC. This section is a brief recapitulation of McDonald and Sibly (2005). In Section 4 the prospect-bargaining model is extended to show how the introduction of a fixed cost of production can explain the concurrence of speed-limit effects with a flat SRPC. Section 5 concludes the paper.

## **2. Keynes and Robinson, wage and price behaviour and behavioural economics**

In their discussion of the determination of the flex-fix pattern of wage and price adjustment at high unemployment, both Keynes and Robinson emphasised the role of ideas that today would be considered as central to behavioural economics. However, as will be seen, they both thought that as of 1936 these ideas were not capable of systematic application given the state at the time of the discipline of social psychology. Robinson was also sceptical about the value of the economic analysis of bargaining over wages.

Keynes contended that workers would resist a reduction in their money wage because they would see such a reduction as a reduction relative to the wages of other workers. This contention is a famous expression of the importance of context in

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union power. According to the pattern of  $u^{\min}$  implied by these estimates, both the US and Australia experienced significant excess demand in the 1960s and early 1970s. Thus the accelerationist hypothesis, a central element of the natural rate view, is supported by these estimates.

economics and is reasonably viewed as a pre-cursor of the current interest in context in behavioural economics and prospect theory. Keynes (1936, p.14) said “(A)ny individual or group of individuals, who consent to a reduction of money wages relatively to others, will suffer a relative reduction in real wages, which is sufficient justification for them to resist”. In Keynes’ view, the desire to protect wage relativities is strong even when unemployment is high, in that workers “resist reductions of money wages, which are seldom or never of an all-round character, even though the existing real equivalent of these wages exceeds the marginal disutility of the existing employment”, Keynes (1936, p.14).

Keynes’ views on wage determination are consistent with the role of loss aversion. Thus Keynes (1936, p.15) said “Every trade union will put up some resistance to a cut in money wages, *however small*” (my emphasis). This implies a discontinuity in the marginal utility of wages at the current level of the wage, which is the implication of prospect theory and loss aversion as applied to wage determination in the prospect-bargaining model.<sup>19</sup>

Whilst Keynes considered at length the consequences of different assumptions about wage behaviour, especially contrasting the consequences of “falling without limit” with “find a level”, he did not develop his theory of wage determination any further than these statements on pp.14-15 of the General Theory. He alluded to the influence of the “psychology of the workers” Keynes (1936, p.301) but drew back from further analysis, saying that such considerations “do not readily lend themselves to theoretical generalisations”, Keynes (1936, p.302).

In her chapter on “Indeterminacy”, Robinson (1937, pp.171-4) put forward a dichotomous approach to economic analysis by drawing a distinction between economic and non-economic factors. In Robinson’s definition, indeterminacy for economists arises when economic factors are insufficient to determine a unique solution. Robinson included “human error or sentimentality” in her list of non-economic factors. These factors, she argued, “cannot be easily fitted into the existing structure of pure economic analysis”, Robinson (1937, p.171), and suggested that “the

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<sup>19</sup> In the prospect-bargaining model, loss aversion plays a crucial role in generating the fundamental Keynesian proposition. The prospect-bargaining model shows that a concern for wage relativities based on loss aversion creates the behaviour consistent with the fundamental Keynesian proposition. Without the influence of loss aversion on wage relativities, and without the discontinuity in the firm’s marginal revenue function, the prospect-bargaining model reduces to a natural rate model in which the fundamental Keynesian proposition does not hold.

economist must wait for the development of a science of social psychology to supplement his own methods of analysis”, Robinson (1937, p.172).

Robinson was dismissive of the idea that economic analysis could show much insight into bargaining. In Robinson (1937, p.4) she said, “It is idle to attempt to reduce such questions as Trade Union policy to a cut and dried scheme of formal analysis”. In keeping with this view, in her discussion of non-economic factors referred to above, Robinson included “the strategical position of trade unions”, Robinson (1937, p.171). However, she did think that judgements could be made “in a more general way” about wage determination, Robinson (1937, p.4), ie not made according to a cut and dried scheme.<sup>20</sup> Given that in making these judgements she referred to the “existing” structure of economic analysis and that she entertained the possibility of future developments in social psychology, Robinson did not close the door on a broader analysis being developed in the future.

Robinson was highly skilled in pure economic analysis. She wrote many articles and books on pure economic analysis. And yet she recognised that pure economic analysis as in 1936 ignored many factors, such as social psychology and bargaining, that are important for real world outcomes. Her way of resolving this tension in the absence of a formal analysis of these factors was the indeterminacy method, as illustrated by the following statement on economic method:

“It is a great merit of the General Theory of Employment that it allows us to believe that the general level of prices is determined very largely by arbitrary human decisions, and saves our self respect by leaving us such problems as the determination of the level of real wages and the amount of employment to be discussed by the methods of pure economic analysis”. Robinson (1937, pp.174).

Robinson’s indeterminacy method postulates that the determination of crucial magnitudes, in particular money wages, are outside of economic theory.

Subsequently, with the natural rate revolution of 1968, the macroeconomic mainstream brought the determination of money wages back into the purview of economic analysis. However, in doing that classical methods were applied. Given the

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<sup>20</sup> Thus Robinson did theorise about sentiment and trade union bargaining. She talked of, in situations of high unemployment, tacit agreements among workers to prevent underbidding of wages, an idea developed later in Solow (1990), and, in situations of low unemployment, of how collusion amongst employers to prevent wage increases may be undermined by “dastardly acts” by individual employers, see Robinson (1937, p.6 and p.9).

advances in behavioural economics that have occurred since 1936, and 1968, Robinson's dichotomy can now be replaced, or at least modified, by using systematic analysis from prospect theory and bargaining theory to determine money wages.<sup>21</sup>

### Section 3 The prospect-bargaining model and the flat SRPC

In this section a brief exposition of the prospect-bargaining model of McDonald and Sibly (2005) is presented as a basis for the extension developed in Section 4. The prospect-bargaining model is based on reference dependence and loss aversion in buyer-seller relationships in wage bargaining and in selling goods. Asymmetric information also plays a role. The microfoundations of the prospect-bargaining model are discussed in McDonald and Sibly (2005).

In McDonald and Sibly (2005), the bargaining problem between worker and firm is written:

$$\text{Maximise}_{V,L} \quad NM = [U(V, V/V^{\text{REF}}) - U(V^{\text{RES}})]^\phi [R(L, L^E/\bar{P}) - VL]^{(1-\phi)} \quad (1)$$

where  $V$ =real wage,  $V^{\text{REF}}$ =worker's reference real wage,  $V^{\text{RES}}$ =worker's reservation real wage,  $L$ =employment at the firm,  $\bar{P}$ =aggregate price level,  $\phi$  is the relative power in bargaining of the worker(s) ( $0 < \phi < 1$ ).  $L^E$  is the level of employment at which the firm's price is equal to its reference price,  $P^{\text{REF}}$ .  $[U(V, V/V^{\text{REF}}) - U(V^{\text{RES}})]$  and  $[R(L, L^E/\bar{P}) - VL]$  are the net gains from the bargain to the workers and the firm respectively, with  $U(\cdot)$  and  $R(\cdot)$  being a worker's utility function and the firm's revenue function respectively.<sup>22</sup> To clarify the discussion of the model, it helps to use specific functional forms for these functions.

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<sup>21</sup> Robinson paid little attention to wage and price determination over the rest of her career. Her research focussed on economic growth, including the analysis of aggregate demand in the long run, and on criticising the equilibrium method. Her criticism of the aggregate production function is one example of the latter. A 'cut and dried' analysis of money wage and price determination remained off-limits, see for example her essay on stagflation, Robinson (1980, ch.3).

<sup>22</sup> Note that employment does not enter the payoff to the worker. This payoff is the specification in the model of the insider-dominated union as in McDonald (1991). The idea is that the unemployed workers and those workers facing significant risk of unemployment have no influence over bargaining, because unemployed workers are not members of the union and workers at risk of unemployment are too junior to count effectively in the union's decision-making, reflecting the impact of a seniority system in layoffs. Because of this the union is not concerned about the implication of the bargained wage for

To capture loss aversion of workers, specify the worker's utility function,  $U(V, V/V^{\text{REF}})$  as

$$U(V, V/V^{\text{REF}}) = BV^{\beta_1}(V/V^{\text{REF}})^{\beta_2^-} \quad \text{for } V < V^{\text{REF}}$$

$$U(V, V/V^{\text{REF}}) = BV^{\beta_1}(V/V^{\text{REF}})^{\beta_2^+} \quad \text{for } V \geq V^{\text{REF}}$$

and

$$U(V^{\text{RES}}) = BV^D{}^{\beta_1},$$

with  $0 < \beta_1, \beta_2 < 1$  and  $0 < \beta_2^+ < \beta_2^- < 1$ .<sup>23</sup>

The prospect-bargaining model assumes that goods are sold in customer markets and that the customer market effect is captured by a kink in the demand curve.<sup>24</sup> The firm's revenue function is  $PY$  with  $P$  and  $Y$  being determined as follows. To capture the kink implied by customer market analysis, specify the firm's demand function as  $P = C^- Y^{\chi^-}$  for  $Y \leq Y^E$ ,  $P = C^+ Y^{\chi^+}$  for  $Y > Y^E$ , with  $-1 < \chi^+ < \chi^- < 0$  and  $C^- / C^+$  set such that, to ensure a continuous demand curve at  $\{Y^E, P^{\text{REF}}\}$ ,

$$C^- [Y^E]^{\chi^-} = C^+ [Y^E]^{\chi^+}. \quad \text{The firm's production function is written } Y = AL^\alpha - F,$$

where  $A > 0$  is the efficiency parameter,  $\alpha$  is the measure of the marginal productivity of labour and  $F$  is an avoidable fixed cost component in the firm's production function. The motivation for including a fixed cost is, as explained in the introduction, to capture the empirical finding of Akerlof, Dickens and Perry (1996), Bewley (1999) and Henle (1973), that a pressure on profits can induce wage concessions.

By 'avoidable fixed cost' is meant a fixed cost that can be avoided by closing down the firm or plant. This captures for example a production process where a minimum positive number of workers, denoted  $\hat{L} = (F/A)^{1/\alpha}$ , is required to operate a production process.

With these specific functional forms, there is, for the firm, a set of equilibrium values of  $L$  and  $V$  that maximise the Nash maximand as defined by (1) such that price

employment. However re-specifying the payoff to incorporate the level of employment does not change the results.

<sup>23</sup> Bhaskar (1990) introduced loss aversion into wage bargaining.

<sup>24</sup> In customer market analysis, two mechanisms that determine such a kink have been developed in the literature. First, there is the Scitovsky effect, introduced by Scitovsky (1952, pp.272-81). According to the Scitovsky effect, price increases will induce a rapid decrease in sales while price decreases will induce a slow increase in customers. Second, from prospect theory, loss averse customers may react more strongly to price increases than to price decreases, see Sibly (2002).

and real wage are both equal to their respective reference levels, that is  $P=P^{\text{REF}}$  (and thus  $L=L^{\text{E}}$ ) and  $V=V^{\text{REF}}$ . This set of equilibria is determined as follows. First, assuming the real wage is equal to  $V^{\text{REF}}$ , from partial differentiation with respect to  $L$ , that is holding  $V$  and  $L^{\text{E}}$  constant, of the objective function of the cooperative bargain (1) it can be shown that equilibrium levels of  $L$  lie within a range of employment levels from  $L^{\text{LOW}}$  to  $L^{\text{HIGH}}$  which are determined by (2) and (3)<sup>25</sup>:

$$\bar{P}V = C(\chi^+ + 1) \left[ A[L^{\text{LOW}}]^\alpha - F \right]^{\chi^+} \alpha A[L^{\text{LOW}}]^{\alpha-1} \quad (2)$$

$$\bar{P}V = C(\chi^- + 1) \left[ A[L^{\text{HIGH}}]^\alpha - F \right]^{\chi^-} \alpha A[L^{\text{HIGH}}]^{\alpha-1}. \quad (3)$$

(2) and (3) show minimum and maximum values of the bargained employment level, given the level of real wage and given the equality of the price with the reference price. Second, from partial differentiation with respect to  $V$ , holding  $P$  and  $L^{\text{E}}$  constant, it can be shown that equilibrium levels of  $V$  lie within a range of real wage levels from  $V^{\text{LOW}}$  and  $V^{\text{HIGH}}$  which are determined by (4) and (5):

$$V^{\text{LOW}} = \left[ 1 - \frac{\phi(\beta_1 + \beta_2^+)}{1 - \phi} \left( \frac{\left(1 - \frac{F}{AL^\alpha}\right)}{(\chi^- + 1)\alpha} - 1 \right) \right]^{\frac{-1}{\beta_1}} V^{\text{RES}} \quad (4)$$

$$V^{\text{HIGH}} = \left[ 1 - \frac{\phi(\beta_1 + \beta_2^-)}{1 - \phi} \left( \frac{\left(1 - \frac{F}{AL^\alpha}\right)}{(\chi^+ + 1)\alpha} - 1 \right) \right]^{\frac{-1}{\beta_1}} V^{\text{RES}} \quad (5)$$

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<sup>25</sup> To determine (2) and (3) note that at  $L=L^{\text{E}}$ , the derivative of profit with respect to  $L$  is discontinuous. In order that  $L=L^{\text{E}}$  generate a profit maximum, both the left-hand and right-hand derivatives of profit with respect to  $L$ , written  $\Pi_{L,L=L^{\text{E}}}^-$  and  $\Pi_{L,L=L^{\text{E}}}^+$  respectively, must be equal to or less than zero. (2) is the level of  $L=L^{\text{E}}$  such that  $\Pi_{L,L=L^{\text{E}}}^- = 0$  is zero and (3) is the level of  $L=L^{\text{E}}$  such that  $\Pi_{L,L=L^{\text{E}}}^+ = 0$ . The basis for (4) and (5) is similar.

(4) and (5) represent minimum and maximum values of the bargained real wage, given the level of employment and given the equality of the real wage with the reference real wage.

The equilibria defined by (2) to (5) are partial equilibria, dependent on an exogenous general price level  $\bar{P}$ . For general equilibria, assume all firms in the economy are the same and add the constraint  $P=\bar{P}$  =the price at any particular firm (=the aggregate price level). Setting the number of firms equal to one, general equilibrium requires writing (2) and (3) as (6) and (7):

$$V=(\chi^+ +1)\alpha A [L^{\text{LOW}}]^{\alpha-1} \quad (6)$$

$$V=(\chi^- +1)\alpha A [L^{\text{HIGH}}]^{\alpha-1} \quad (7)$$

(4) and (5) are not affected by the  $P=\bar{P}$  general equilibrium condition. So the macroeconomic general equilibrium model of the prospect-bargaining model is given by equations (4) to (7).

Differentiation of (6) and (7), called the  $L^{\text{LOW}}$  and  $L^{\text{HIGH}}$  curves, shows that  $L^{\text{LOW}}$  and  $L^{\text{HIGH}}$  are negatively related to the real wage. Differentiation of (4), called the  $V^{\text{LOW}}$  curve, reveals that the slope of the  $V^{\text{LOW}}$  curve can be written as

$$\frac{dV^{\text{LOW}}}{dL} = \frac{1}{\beta_1} \left[ \frac{V^{\text{LOW}}}{V^{\text{RES}}} \right]^{\beta_1-1} \frac{\phi(\beta_1 + \beta_2^+)}{(1-\phi)(\chi^- + 1)\alpha} \frac{\alpha F}{AL^{\alpha+1}} V^{\text{D}} \geq 0 \text{ as } F \geq 0$$

A similar equation describes the slope of the  $V^{\text{HIGH}}$  curve. Thus  $V^{\text{LOW}}$  and  $V^{\text{HIGH}}$  are positively related to  $L$  if  $F > 0$ . These curves are depicted in Figure 2. The diamond-shaped area lying between the four curves, labelled diamond of equilibria, is the set of equilibrium macroeconomic outcomes.

Note that the  $V^{\text{LOW}}$  and  $V^{\text{HIGH}}$  curves are drawn to fall away as  $L$  falls, ending at  $\{L=\hat{L}, V=V^{\text{RES}}\}$ .<sup>26</sup> This is because revenue net of the fixed cost falls as employment falls. If fixed costs were not included then the  $V^{\text{LOW}}$  and  $V^{\text{HIGH}}$  curves

<sup>26</sup> Inspection of (4) and (5) shows that at  $L=\hat{L}$ , and thus  $AL^\alpha=F$ ,  $V^{\text{LOW}}=V^{\text{HIGH}}=V^{\text{RES}}$ .

would be horizontal, reflecting the constancy, in Cobb-Douglas fashion, of factor shares.

One could assume that  $V^{\text{RES}}$  is influenced by market pressure and so model  $V^{\text{RES}}$  as negatively related to the rate of unemployment. (Assuming for convenience that the labour force is fixed, the rate of unemployment =  $1 - (L/\text{labour force})$ .) That would increase the upward slope of the  $V^{\text{LOW}}$  and  $V^{\text{HIGH}}$  curves. This modification would not change qualitatively the results presented below.

Because the equilibrium wages explained by prospect-bargaining model are in real terms, the move to nominal values of the wage and the price requires elaboration. At an equilibrium outcome it is in principle possible for all nominal values of wages and prices to be changed simultaneously by the same proportion without disturbing the equilibrium as explained in the model. In practice the setting of wages and prices is decentralised and so a simultaneous change would require a coordinating mechanism. The expected rate of inflation is an important coordinating mechanism. A change in the expected price level is a signal for all firms to change prices and money wages. Thus the expected rate of inflation determines, within the diamond of equilibria, the actual rate of inflation. The formation of inflationary expectations and their influence in models of the range of equilibria is discussed in Bhaskar (1990), Woglom (1982) and McDonald and Sibly (2005).

A flat SRPC is implied by real wage and employment outcomes within the diamond of equilibria. For such outcomes, the rate of inflation is independent of the level of activity, ie the SRPC is flat, and is determined by the expected rate of inflation.

#### **4 The speed-limit effect at high rates of unemployment**

As reported in the Introduction, empirical investigations detected, in addition to a flat SRPC, a speed-limit effect, in that wages and prices respond at high rates of unemployment to changes in the unemployment rate. In this section the prospect-bargaining model is shown to be capable of explaining speed-limit effects. Thus a common theoretical basis is shown to explain the concurrence of speed-limit effects with a flat SRPC.

Shown in Figure 2 are areas of ‘downward money wage pressure’, being the area above the  $V^{\text{HIGH}}$  curve, and ‘downward price pressure’, being the area to the left

of the  $L^{\text{LOW}}$  curve. Aggregate demand shocks that push the real wage-employment outcome into these areas can cause speed-limit effects. The analysis now demonstrates these two possibilities. In both cases the economy moves temporarily into one of the disequilibrium areas and then moves back into the diamond of equilibria, settling at a lower level of employment.

Consider first a movement into the area of downward money wage pressure. In Figure 2 an initial equilibrium is assumed to be at point A. A negative aggregate demand shock that shifts the firm's demand curve horizontally to the left, that is a reduction in the parameter  $C$ , will, at an unchanged real wage, reduce the firm's employment to the level associated with, for example, point B. But this is a real wage that, being at a point above the  $V^{\text{HIGH}}$  curve, exceeds the maximum real wage consistent with cooperative bargaining. The pressure on factor rewards will cause the workers and the firm to bargain the real wage downwards.<sup>27</sup>

For the bargained real wage to fall, from its level at point B, the bargained money wage has to fall. This is because there is no disequilibrium pressure on the price of the firm's output. To see this, note that at point B the real wage and the level of employment are between the  $L^{\text{LOW}}$  and  $L^{\text{HIGH}}$  curves and so the firm's marginal cost has been within the range of marginal revenue; that is, from (6) and (7),

$$(\chi^+ + 1)P < \frac{W}{\alpha AL^{\alpha-1}} < (\chi^- + 1)P \text{ is satisfied. Thus at point B there is no pressure for}$$

price to change and, for the real wage to fall, the money wage has to fall.

In this response to the aggregate demand shock, the firm's money wage has fallen. For this process of downward real wage adjustment to reach an equilibrium

<sup>27</sup> Bargained real wage outcomes in the region of downward money wage pressure will be less than the reference real wage outcome that supports them. To see this consider

$$\frac{\phi(\beta_1 + \beta_2^-)}{(1 - K^*)} = \frac{(1 - \phi)V^*L}{\left[ C(AL^\alpha - F)^{\chi+1} - V^*L \right]}, \text{ where } K^* = \left( \frac{V^{\text{RES}}}{V^*} \right)^{\beta_1} \left( \frac{V^{\text{REF}}}{V^*} \right)^{\beta_2^-} \text{ and the star denotes the}$$

bargained outcome. This is the equation that the bargained real wage has to satisfy, according to the first order condition of NM with respect to  $V$  for bargained real wages equal to or greater than those levels on the  $V^{\text{HIGH}}$  curve. On the  $V^{\text{HIGH}}$  curve this equation will hold with  $V^{\text{REF}} = V$ . Differentiating this equation with respect to  $V^{\text{REF}}$ , holding  $L$  constant yields

$$\frac{dV^*}{dV^{\text{REF}}}\bigg|_{dL=0} \frac{V^{\text{REF}}}{V^*} = \frac{\beta_2^-}{\frac{1}{V^{\text{REF}}} \frac{\phi[\beta_1 + \beta_2^-]}{K^*(1-\phi)} + (\beta_1 + \beta_2^-)} < 1. \text{ Thus moving vertically above the } V^{\text{HIGH}} \text{ will}$$

increase the bargained real wage by less than the reference real wage outcome implying that bargained real wage outcomes above the  $V^{\text{HIGH}}$  curve will be less than the reference real wage. Thus, in Figure 2 the bargained real wage will fall with a reduction in the level of employment from that given at point A to that given at point B. A similar property holds for the region of upward money wage pressure.

according to the definition used in Section 3.2 to establish the  $V^{\text{HIGH}}$  curve, the reference real wage will also have to fall, ie along the  $V^{\text{HIGH}}$  curve the real wage is equal to the reference real wage. Such an adjustment is reasonable because reference levels are usually thought to be influenced by actual outcomes, see eg Kahneman, Knetsch, and Thaler (1991). A downward adjustment in the reference real wage to  $V_2$  will ensure that the outcome C on the  $V^{\text{HIGH}}$  curve will satisfy the definition of equilibrium.

The anticipation, in wage bargaining, of the downward movement in the reference real wage, may change the speed of the response of money wages but not the direction nor the existence of a final equilibrium point.

Thus the negative aggregate demand shock has caused the money wage to decrease and then to stop or settle at a lower level of activity. A flex-fix pattern of wage adjustment has occurred, with the final equilibrium being at a different level of activity from the initial equilibrium. Thus we have a theoretical explanation of the concurrence of a flat SRPC and speed-limit effects in wages.

Now consider a movement into the area of downward price pressure. In Figure 2 the initial equilibrium is assumed to be at point D. A negative aggregate demand shock that shifts the firm's demand curve horizontally to the left will, at an unchanged real wage, reduce the firm's employment to the level associated with point E. But at this outcome, being at a point to the left of the  $L^{\text{LOW}}$  curve, marginal cost is less than the range of marginal revenues, that is, using (6) and (7),

$\frac{W}{\alpha AL^{\alpha-1}} < (\chi^+ + 1)P < (\chi^- + 1)P$ . There will be disequilibrium pressure pushing the firm to cut its price. For this process of downward price adjustment to reach an equilibrium as defined by the  $L^{\text{LOW}}$  curve, the reference price and the reference real wage will also have to adjust. An outcome such as F on the  $L^{\text{LOW}}$  curve accompanied by a downward adjustment in the reference price and an upward adjustment in the reference real wage will satisfy the definition of equilibrium. Thus prices will have decreased and then stopped. A flex-fix pattern of price adjustment will have occurred, with the final equilibrium being at a different level of activity from the initial equilibrium. Thus we have another theoretical demonstration of the concurrence of a flat SRPC and speed-limit effects, this time in prices.

The adjustment required to return from the region of downward price pressure to equilibrium is more complicated than the adjustment from the region of downward

wage pressure because both reference levels, price and real wage, have to adjust.<sup>28</sup> The required upward adjustment in the reference real wage implies the possibility that downward price movements may spillover to cause downward money wage movements. This would occur if the reference real wage is slow to adjust upwards. For example, if the reference real wage remains at the level  $V_3$  when demand is restricting employment to the level given by  $E$ , the emerging excess of the real wage over the reference wage caused by the fall in price may be offset by a reduction in the money wage.

Increases in aggregate demand will lead, by similar chains of logic, to wage and price increases. That is, speed-limit effects causing upward wage and price movements will be caused by increases in employment when the economy is pushed into the regions of ‘upward price pressure’ or ‘upward money wage pressure’.

A generalised hypothesis that emerges from this disequilibrium analysis is that downward (upward) speed-limit effects on wages are likely to arise when the wage share is large (small). The converse holds for the speed-limit effects on prices.

To test the generalised hypothesis, the importance of heterogeneity across firms/plants suggests that tests using micro data would be appropriate to see how robustly the theory supports the macro evidence of flat SRPCs combined with speed-limit effects.<sup>29</sup> Of course, as noted above, the empirical evidence in Bewley (1999) and Henle (1973) is consistent with these results.

This generalised hypothesis is derived from analysis based on the assumption that all firms are the same. Relaxing this assumption and allowing for heterogeneity across firms (and plants of firms) in profitability, implies that a decrease in aggregate demand may push some firms into the region of downward wage pressure and some

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<sup>28</sup> Another contrast is that the derivation of the speed limit effect using the region of downward price pressure does not rely on assuming a fixed cost in production.

<sup>29</sup> In adjusting to a substantial decrease in aggregate demand, it is likely that, due to mistakes in wage bargaining, especially irrational intransigence by workers, some firms or plants will close down. In bargaining mistakes are made, for example due to self-serving bias as in Linda Babcock and George Loewenstein (1997), and so some workers will stick out for a wage that is unprofitable, forcing a closure of the plant and large job losses. Davis, Haltiwanger and Schuh (1996) find that a substantial proportion of job destruction is associated with plant closure. Whilst this suggests mistakes in bargaining relative to the prospect-bargaining model, it also suggests that threats of plant closure are a significant element in labour market experience. Note that firm closures shift the relation between the individual firm employment level and the aggregate level of employment. Thus the aggregate level of employment associated with lowest equilibrium level of firm employment shown in Figure 2 would be reduced.

other firms into the region of downward price pressure.<sup>30</sup> An example to illustrate these effects is given in the Appendix. The macroeconomic outcome will be a combination of these different components. Furthermore there may be interactions between the wages and prices at these firms and at other firms who remain within the diamond even as aggregate demand falls. This interaction would be caused by wage and price falls at particular firms being transmitted via the effect on the general wage level and price level to the money wage value of the reference real wage and the reference price of firms within the diamond. These firms within the diamond would reduce both money wages and prices. Thus, allowing for heterogeneity across firms in profitability strengthens the ability of the prospect-bargaining model to imply speed-limit effects and to imply speed limit effects that combine movements in both wages and prices.

Replacing the constancy of  $V^{\text{RES}}$  with respect to the level of activity by a positive relation, reflecting the influence of labour market conditions on  $V^{\text{RES}}$ , would provide an additional reason for the  $V^{\text{LOW}}$  and  $V^{\text{HIGH}}$  curves to be upward sloping and would therefore give further support to the derivation above of the speed-limit effect using the region of downward money wage pressure. As noted, this effect of market forces is not included in the main argument in order to highlight how the model can explain the influences internal to the firm found to be empirically important in Bewley (1999) and Henle (1973).

## 5. Conclusion

This paper has presented a theory that, for an economy operating below potential, explains when prices and wages are flexible and when they are fixed. The particular mix of flex and fix predicted by the theory is that prices and wages will fall, relative to expected levels, when activity falls but will stabilise when activity stabilises. Thus the pattern of price and wage movement is flex followed by fix, that is a flex-fix price pattern. The theory is symmetric, in that prices and wages will increase when activity increases but will stabilise when activity stabilises. In the language of the Phillips curve, the pattern is a short-run Phillips curve (SRPC) that is

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<sup>30</sup> Assuming heterogeneity of profitability across plants is realistic and can be inferred from the well-documented distribution of productivity across firms, even after allowing for the less than complete correspondence between the two, see Foster, Haltiwanger and Syverson (2007, p.1).

flat at high levels of unemployment and is accompanied by speed-limit effects. (Speed limit effects are a negative relation between changes in unemployment and the rate of inflation.) At low levels of unemployment the theory generates, in conventional fashion, a downward-sloping SRPC.

The theory in the paper is also shown to offer a resolution of the criticism made by Krugman (2000) and Mankiw (2006), that macroeconomic research is disconnected from macroeconomic practice. The theory has explicit microeconomic foundations, the requirement of macroeconomic research, and yields macroeconomic behaviour that is consistent with the fundamental Keynesian proposition, that changes in nominal aggregate demand can have real effects through a direct effect on sales. These real effects do not depend on a divergence of expected and actual prices and so their persistence is not dependent on a persistent error in expected prices. The fundamental Keynesian proposition is the centre piece of macroeconomic practice.

While there is plenty of evidence supporting the flex-fix price pattern at high rates of unemployment, even for the extremely large and sustained movements in unemployment in the depression of the 1930s, this pattern has not registered amongst economists in general as an important phenomena requiring explanation. Given the empirical evidence, this is puzzling.<sup>31</sup> It may be because of the dominance in the thinking of macroeconomists since the 1970s of the theory of the natural rate of unemployment. To accommodate fixity in prices, natural rate thinking has suggested to scholars a fix-flex pattern, that is prices are sticky for at most a temporary period of time and will eventually respond to market forces, a fix-flex view. However, this view is inaccurate and misleading.

The theory presented in the paper is an extended version of the prospect-bargaining model of McDonald and Sibly (2005). In the prospect-bargaining model, loss aversion plays an important role in causing rigidities in wages and prices. Workers dislike wage cuts and customers dislike price increases because the consequent losses in utility are large. The asymmetric effect of loss aversion, that is losses are more keenly felt than gains, yields wage and price stickiness over a range of unemployment rates.<sup>32</sup> This range result yields the flat region in the SRPC.

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<sup>31</sup> As noted above, the ignoring of this evidence by economists has been described by Richard Lipsey as a “major scandal”, Lipsey (1997, p.209).

<sup>32</sup> The information asymmetry in customer markets, pointed out by Scitovsky (1952) also plays a role in the micro foundations of the prospect-bargaining model.

The temporary overriding of fix-price behaviour in prices is caused by downward pressure from decreases in costs. This is a conventional story modified slightly for the customer market context. For wages, the mechanism put forward in the paper is novel. The temporary overriding of fix-price behaviour in wages results from postulating a theory in which contractions in demand will put pressure on factor rewards. The introduction into the prospect-bargaining model of a fixed cost of production is shown in the paper to cause pressure strong enough for the stickiness in wages implied by loss aversion to be overridden in the interests of the cooperative wage bargain. The converse holds for increases in aggregate demand, where the sharing of increased revenue can require an increase in real wages.

Thus forces internal to the firm, that is the need to protect income shares, can contribute through wage adjustment to speed limit effects. This is consistent with the empirical evidence gathered by Bewley (1999), who found that depressed labour market conditions external to the firm were of little importance in the determination of wage reductions. What was important, according to Bewley's findings, was the sharing of reduced factor incomes.

The paper also explores some links with the writings in the 1930s of Keynes and Robinson. In his description of the pattern of wage and price adjustment at high unemployment, Keynes described prices as finding "a level at which they can remain, for the time being, moderately stable", Keynes (1936, p.250). In Keynes' view, wages and prices would fall as unemployment increased, but would not "fall without limit". This is the flex-fix pattern. For Keynes the crucial weakness of the classical model was the prediction that wages and prices would fall without limit if unemployment remained high. Robinson (1937) concurred strongly with Keynes' view.<sup>33</sup>

The discussion of Keynes (1936) and Robinson (1937) is shown to foreshadow the use of ideas from behavioural economics, in particular prospect theory and loss aversion, in the modelling of wages and prices. In the 1930s both Keynes and Robinson recognised the importance of psychology in the determination of wages and

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<sup>33</sup> Thus Keynes did not commit himself to the proposition that prices remain at this stable level for all time. Provided prices remain stable for a substantial period of time, the decelerationist hypothesis of classical economics will be irrelevant for practical purposes. As Keynes famously observed, "In the long run we are all dead", Keynes (1923, p.65). Note that in the prospect-bargaining model, because in equilibrium reference prices equal actual prices, the equilibria are self-sustaining. Thus they can last a long time. Whether these equilibria last forever is, in the spirit of Keynes' comment, of secondary importance.

prices. However, they did not develop these insights because they were sceptical of the usefulness at the time of the science of social psychology.

But now things are different. Ideas from the new area of behavioural economics are shown in the paper to be applicable to the study of the inflation-unemployment relation. This application has broader microfoundations than those of mainstream macroeconomics, which has been dominated since 1968 by the rather narrow neoclassical specification of human behaviour. Thus the development of prospect theory has provided tools with which earlier insights, from the 1930s, can be fruitfully developed.

## Appendix A: An example of how heterogeneity across firms in profitability implies a speed limit in both wages and prices

In the model, heterogeneity across firms in the production process can be captured by firm-specific values of the parameters  $A$  and  $F$ . To see how a macro speed limit that combines firm-specific speed limits from the regions of downward money wage pressure and downward price pressure, consider the simple case of two firms with different production technologies. Assume  $A_1 < A_2$ , where the subscript 1 (2) refers to the less (more) productive firm. Assume also, for convenience, that  $F_1 < F_2$  such that  $F_1/A_1 = F_2/A_2$ . This assumption implies that the  $V^{\text{HIGH}}$  and  $V^{\text{LOW}}$  curves for the two firms are coincident, see equations (4) and (5).

Figure A shows an example of this case of differing productivity across two firms. The differing levels of productivity,  $A_1 < A_2$ , is reflected in the  $L^{\text{LOW}, \text{firm1}}$  curve lying to the left of the  $L^{\text{LOW}, \text{firm2}}$  curve. Assume initially the same real wage of  $V_1$  at both firms and the initial equilibrium outcomes of point A for firm 1 and point D for firm 2. These initial outcomes are a macro-equilibrium. Note that employment at the high productivity firm exceeds employment at the low productivity firm. Note also that profitability at the high productivity firm exceeds profitability at the low productivity firm.<sup>34</sup>

Now assume an aggregate demand contraction. For the low productivity firm, the contraction in employment pushes that firm into the region of downward money wage pressure, eg point B. For the high productivity firm, the contraction in employment pushes that firm into the region of downward price pressure, eg point E. As intuition suggests, the low productivity firm is experiencing pressure on factor rewards, because it is operating near to its minimum level of employment. This pressure on factor rewards induces, through cooperative bargaining, wage concessions. For the high productivity firm the lower marginal cost at a lower level of output is the dominant force, inducing the firm to compete in its market for sales by cutting price.

The process of adjustment to general equilibrium will require opposite movements in the real wage at the two firms. The low productivity firm will achieve

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<sup>34</sup> Writing  $x=F/A$ ,  $\Pi = (1-\alpha)\left(\frac{V}{\alpha}\right)^{\frac{\alpha}{\alpha-1}} A^{\frac{1}{1-\alpha}} - xA$  and so  $\frac{d\Pi}{dA} = \left(\frac{V}{\alpha}\right)^{\frac{\alpha}{\alpha-1}} A^{\frac{1}{1-\alpha}} - x = \alpha\left(\frac{V}{\alpha}\right)^{\frac{\alpha}{\alpha-1}} A^{\frac{\alpha}{1-\alpha}} > 0$ .

equilibrium when its reference real wage has adjusted to a lower level such as given by point C. For the high productivity firm equilibrium is achieved when its reference real wage has adjusted to a higher level such as given by point F. This divergence of real wages reflects the divergent productivity levels of the two firms.

Thus, as concluded in the text, a decrease in aggregate demand has pushed one firm into the region of downward wage pressure and the other firm into the region of downward price pressure. The macroeconomic outcome will be a combination of these different components. Thus, allowing for heterogeneity across firms in profitability can lead to a macro speed limit effect that combines movements in both wages and prices.

## **Appendix B: Keynes, Robinson and the empirical pattern of wage and price behaviour**

In the General Theory, Keynes (1936) reported his observation of a pattern of wage and price behaviour that is consistent with the concurrence of a steep SRPC at low unemployment, a flat SRPC at high unemployment and speed-limit effects. His disciple, Robinson at the same time, in a set of essays commenting on and extending ideas in the General Theory, Robinson (1937), elaborated on this pattern. Both Keynes and Robinson contrasted their observations with the empirical implications of classical theory. This appendix documents these observations and views and complements section 2 of the paper, which draws out the potential role of behavioural economics suggested by Keynes and Robinson in their discussion of the causes of the empirical pattern of wage and price behaviour that they observed.

The deep recession of the 1930s, the initiating cause of macroeconomics as a distinct area in economics, was characterised by a pronounced speed-limit effect combined with a flat SRPC, that is a flex-fix pattern of wage and price adjustment. This pattern can be seen with the aid of Figure B, in which wage inflation and unemployment for Australia, UK and US are plotted for the years 1929 to 1938. (Price inflation yields a similar story).

For each of these economies, the initial impact of the recession was to decrease wages, a flex-price response. Thus from 1929 to 1931/1932, wage inflation decreases in each of these economies. The decrease is smaller for the UK, but is still noticeable.

The initial flex-price response is followed, after 1931/1932, by fix-price behaviour. That is, it can be seen clearly in all three economies that inflation stopped decreasing in 1931/1932 even although unemployment remained high. This experience counts against the decelerationist hypothesis.

Keynes' used the expression "fall without limit" to denote the case against which he argued. Figure 1 supports Keynes' view by showing that "fall without limit" was not how wages behaved in the three economies shown. Note that to say wages and prices do not "fall without limit" does not say they are fixed, ie do not fall. Figure 1 shows that wages did fall. The point is that wages stopped falling even although unemployment was very high. This contradicts flexible in the sense of the classical

model and the associated decelerationist hypothesis, that wages and prices continue to fall at an increasing rate as long as excess supply exists in the economy.

A similar pattern, that is flex followed by fix, is shown for the 1930s for all countries for which data is reported in Maddison (1991), see McDonald (1995), a chapter in Cross (1995). This pattern is not restricted to the 1930s. For example, there is a similar pattern in Australia, Germany, UK and US in response to the recession of the early 1980s, see McDonald (1995). For those economies, inflation initially fell as unemployment rose but this fall stopped while unemployment remained high.

Also shown in Figure B is the Phillips curve, as estimated by Phillips (1958). This estimate is based on wage data for the UK for the period 1861 to 1913. The flat section at high rates of unemployment is consistent with fix-price behaviour because it shows little or no impact on inflation of high rates of unemployment. Phillips also found that the rate of inflation was positively related to changes in the rate of unemployment, a relation subsequently called the Phillips loops and now often referred to as the speed-limit effect.

At low rates of unemployment Phillip's estimates show a strong negative inflation-unemployment relation. Indeed the curve approaches vertical as unemployment falls to low levels. So the pattern of inflation at these low unemployment rates appears to be determined by classical demand and supply and does not contradict the accelerationist hypothesis.

Keynes focussed on high rates of unemployment and did not subject low unemployment to detailed analysis. However, he made clear that to expand aggregate demand above the full-employment level would cause inflation. Thus Keynes said, from a position of full employment "(W)hen a further increase in the quantity of effective demand produces no further increase in output and entirely spends itself on an increase in the cost-unit fully proportionate to the increase in effective demand, we have reached a condition which might be appropriately designated as one of true inflation", Keynes (1936, p.303). This situation of true inflation was also described by Keynes as "inflation sets in", Keynes (1936, p.303), which could be interpreted as a veiled reference to the role of inflationary expectations. However, there is no explicit discussion of inflationary expectations in the General Theory and so Keynes' analysis does not explicitly set out the accelerationist hypothesis.

For high rates of unemployment Keynes regarded the pattern of wage and price adjustment to follow a flex-fix price pattern. There is an "asymmetry on the two

sides of the critical level above which true inflation sets in”, Keynes (1936, p.303). On the high-unemployment side, Keynes’ contention that classical flex-price behaviour is unrealistic is the foundation of his macroeconomic analysis. An initial disturbance was seen by Keynes as capable of causing changes in wages and prices. Thus he suggested that at less than full employment, “an increasing effective demand tends to raise money-wages though not fully in proportion to the rise in the price of wage-goods; and similarly in the case of a decreasing effective demand”, Keynes (1936, p. 301). However, this adjustment was seen by Keynes as short-lived. Keynes said that at high rates of unemployment, prices “in response to an initiating cause of disturbance, seem to be able to find a level at which they can remain, for the time being, moderately stable”, Keynes (1936, p.250).<sup>35</sup> Thus he was observing the pattern of flex followed by fix. Keynes contrasted this behaviour with the flex-price behaviour of classical theory using the expression “fall without limit” to describe classical flex-price behaviour when the economy is at less than full employment, see eg Keynes (1936, p.253 and pp.303-4). Fall without limit is consistent with the decelerationist hypothesis. Keynes regarded the classical mechanism of price behaviour, “fall without limit”, as empirically irrelevant for an economy at less than full employment and thus rejected the deceleration hypothesis.

In the General Theory there is a tension between the formal model and the discussion of the empirical pattern of wage and price behaviour. In the model, at high rates of unemployment the money wage is assumed to be fixed.<sup>36</sup> However, in the empirical discussion, it is clear that Keynes regarded as realistic a flex-fix price pattern in which prices and wages will fall with limit if aggregate demand contracts below the full employment level. Keynes was prepared to use an oversimplified model, that is a model with fix-price rather than a flex-fix price pattern, as the basis for his revolutionary analysis of aggregate demand. The importance, and urgency, of replacing the analysis of unemployment based on the flex-price classical model with an aggregate demand approach was overwhelming. A more realistic approach based on a flex-fix pattern of wages and prices could wait further developments.<sup>37</sup> The

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<sup>35</sup> The qualification “for the time being” is discussed below.

<sup>36</sup> “...we shall assume that the money-wage and other factor costs are constant per unit of labour employed”, Keynes (1936, p.27).

<sup>37</sup> When, in Chapter 19, Keynes did consider changes in money wages his analysis was based on classical money-wage flexibility, not the flex-fix price pattern he saw in the data. His focus was to attack the possibility that, from a position of high unemployment, classical money-wage flexibility could generate a full-employment outcome on the grounds that with classical money-wage flexibility

prospect-bargaining model as extended in this paper, being a theory consistent with Keynes' empirical discussion of a flex-fix pattern of wage and price behaviour and Keynes' aggregate demand analysis, provides a resolution of this tension in the General Theory.

Robinson (1937) discussed in greater detail the pattern of wage and price behaviour, including a detailed discussion of the inflationary dangers when the economy is at full employment. "Dangers" is appropriate to describe her fears. In a chapter devoted to full employment, Robinson argued that the "demand for higher money wages...becomes overwhelmingly strong" when full employment is reached and that aggregate demand in excess of the full-employment level will, through competition between employers for labour, cause increases in wages, Robinson (1937, pp.11-13). Robinson went on to set out the accelerationist hypothesis. She argued that, if excess demand is maintained, then the expectations of entrepreneurs about the future course of wages and of prices will determine the course of events. Inflationary expectations were argued by Robinson to be revised in the light of experience. Noting that "the more rapidly are the expectations of entrepreneurs revised the more rapid will be the rise in money wages", Robinson suggested that "expectations will be revised more rapidly as experience teaches the entrepreneurs that a rise in costs in their own industries is accompanied by a rise in prices in others. Thus the rate of rise in money wages will accelerate as time goes on. In the limit...if expectations are revised instantaneously money wages must rise indefinitely fast". Robinson (1937, p.14)<sup>38</sup>

While Robinson accepted, indeed put forward, the accelerationist hypothesis as the likely outcome at low rates of unemployment, for high rates of unemployment, she rejected its symmetric converse, the decelerationist hypothesis. Robinson said that the "assumption of perfectly plastic money wages is highly unrealistic" and thought that, echoing Keynes' terminology, "a community in which money wages fall without limit so long as unemployment exists is very unlike the real world", Robinson (1937, p.88, (p.122 in 1937 edition)). However, she also allowed for speed-limit effects in

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disequilibrium would likely be unstable. This negative focus allowed him to avoid putting forward a theory to explain the actual movements, at high unemployment, of money wages, the flex-fix pattern, which he observed in the data.

<sup>38</sup> On the next page, Robinson introduced the idea of contracts such that "wage bargains can only be altered by discrete steps and at discrete intervals of time", thereby anticipating the staggered contracts model which is the foundation of New Keynesian theory. However, as will be seen, Robinson's analysis of wage stickiness at high unemployment did not rely on the staggering of contracts.

wages at high unemployment, saying “(A)n increase in effective demand...will be favourable ...to a rise in money wages” Robinson (1937, p.3) and that trade unions will demand “higher wages as unemployment falls off...conversely when effective demand declines”.

Thus for Robinson the pattern of wage and price behaviour is consistent with the concurrence of a steep SRPC at low unemployment, a flat SRPC at high unemployment and speed-limit effects. Her analysis parallels that of Keynes, but has more detail.<sup>39</sup>

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<sup>39</sup> As noted in the Introduction, Robinson (1962, pp.73-4) also discussed a variable price-cost mark-up in terms consistent with customer-market analysis.

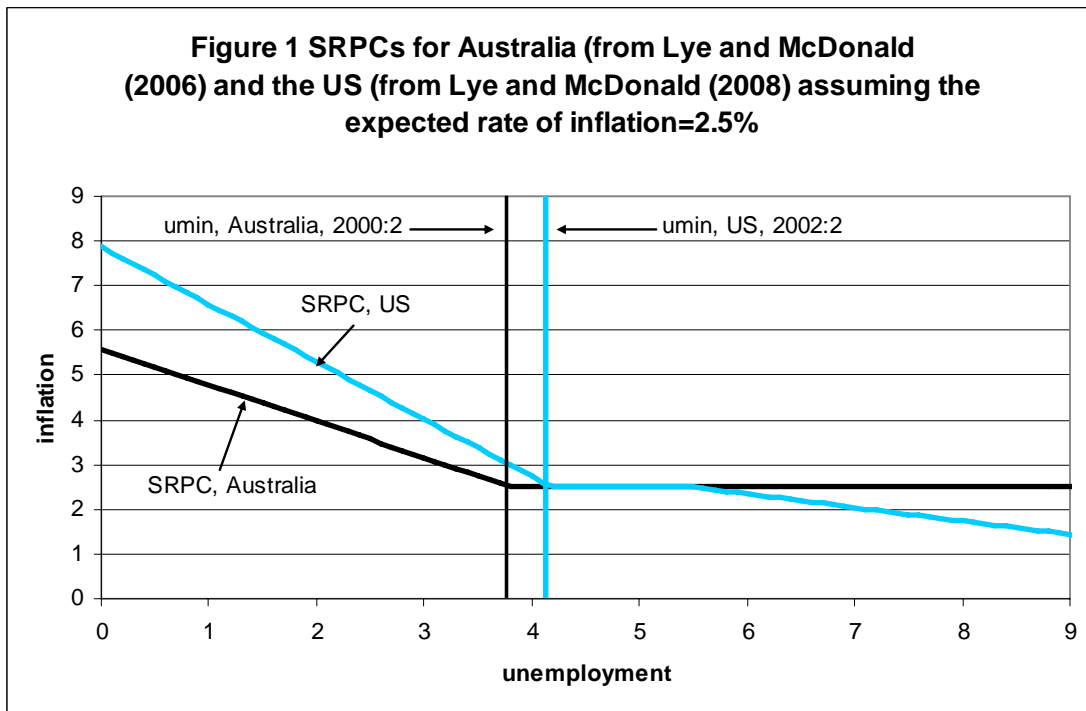


Figure 2 Equilibria and disequilibria in the prospect-bargaining model

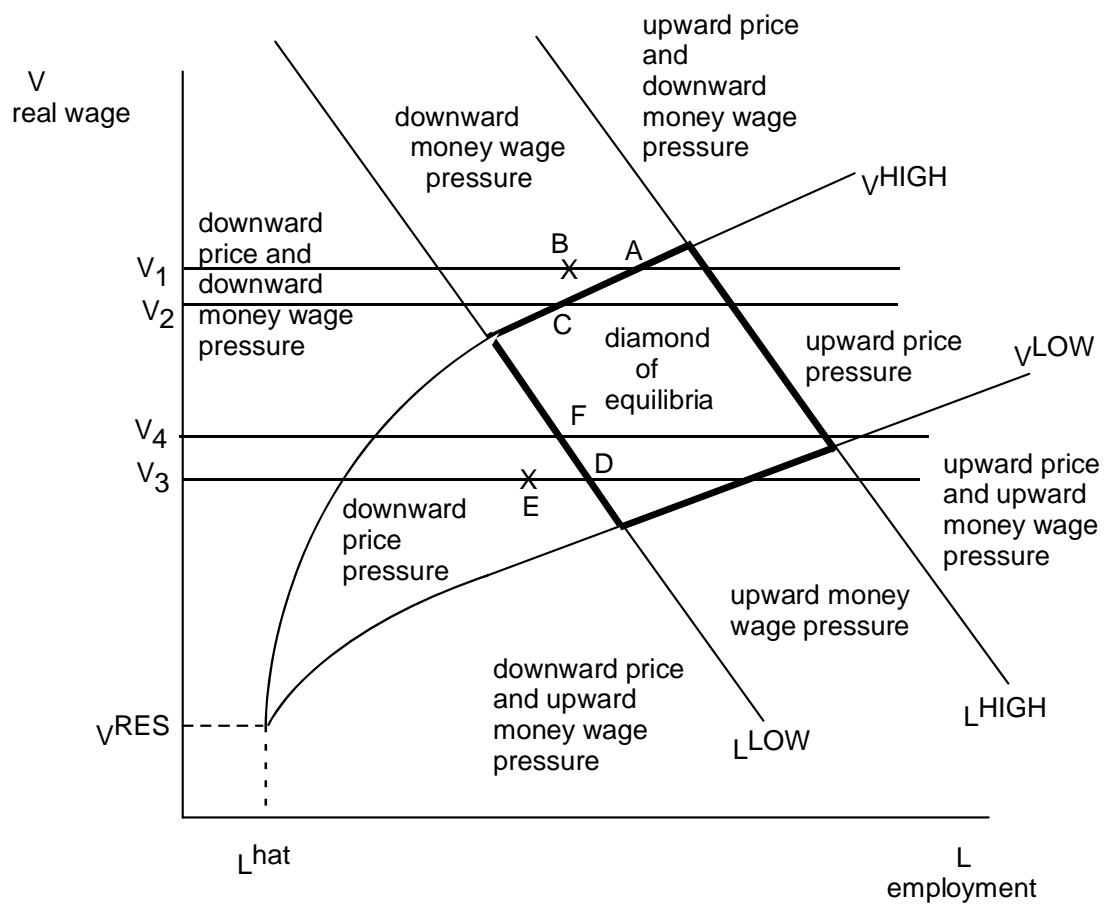
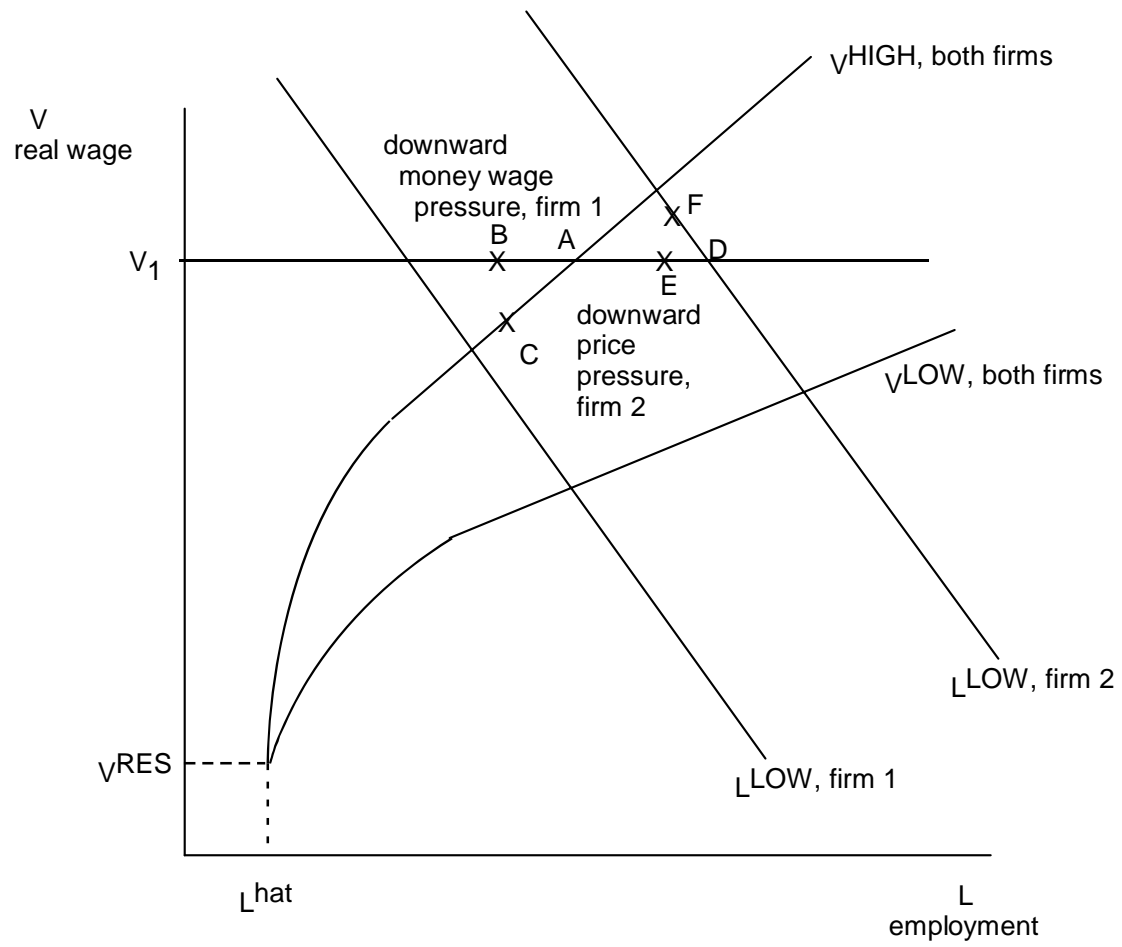
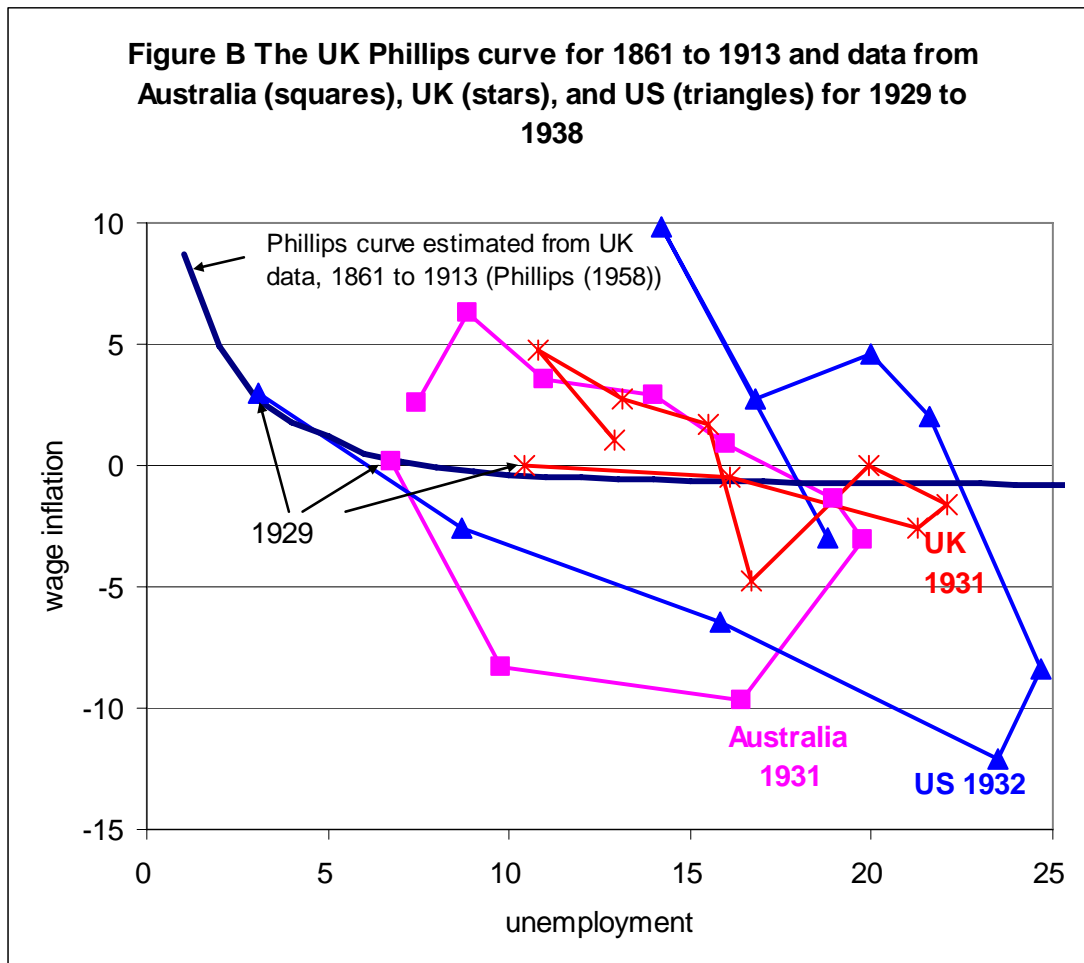


Figure A Two heterogeneous firms and the concurrence of downward money wage and price speed limit effects





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