Neoclassical Macroeconomics and Monetary Non-neutrality

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Abstract

Although it is enjoying an expanded presence in the undergraduate macroeconomic canon, the influence and importance of the classical/neoclassical model as a teaching tool remains severly restricted by its emphasis on monetary neutrality. This paper presents an intermediate-level presentation of a neoclassical model augmented with a generic pricing friction. Monetary policy will be effective in this framework, and all of the model's top-line results are consistent with those obtained from a typical Keynesian model. The model presented here is general enough to be used in conjunction with virtually all of the textbook presentations of the classical/neoclassical model.

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1. Introduction

Although it has been out of favor with most academic macroeconomists for 25 years, the *IS-LM* model remains the core teaching tool in undergraduate macroeconomics. It is the case that virtually every intermediate macroeconomics text presently in print is strongly rooted in Keynesian theory and logic, and the very things modern macroeconomists hold sacred (microfoundations, expectations, dynamic decision making, permanent income, etc.) are typically presented to undergraduates only after they are finished with the standard *IS-LM* paradigm. While macroeconomics is admittedly a discipline in theoretical flux, it is somewhat troubling to note that undergraduate macroeconomics is falling further and further behind the current state of thinking within the academic community.

Neoclassical theory is the most frequently mentioned alternative for the Keynesian *IS-LM* framework, but textbook options for instructors is very limited. Barro's *Macroeconomics* (1997) is the only mass-marketed undergraduate macroeconomics textbook that takes a firmly neoclassical approach, yet this text is often criticized as being unwieldy and high maintenance. Newer macroeconomics textbooks (and editions) may contain a chapter or two or section on neoclassical macroeconomics and general equilibrium (Abel and Bernanke, 2001; Dornsbusch et. al, 2001; Farmer, 2001; Sachs and Larrain, 1993), but the focus of these texts remains decidedly Keynesian.

The neoclassical approach is also sharply criticized for its emphasis on real disturbances—namely productivity shocks—as the principal source of business cycle behavior, at the expense of policy-driven fluctuations. While this criticism is untrue with regard to public spending and taxation—fiscal and tax policy are real disturbances, and an appropriately developed neoclassical model can generally deliver all of the standard fiscal policy results, including higher real interest rates and crowding out, even in a Barro-Ricardian equivalence environment—it is justified with regard to monetary policy, as money is neutral in the basic neoclassical environment.

Therein lies the major stumbling block for the textbook neoclassical approach. Monetary neutrality, for example, makes using a neoclassical framework to examine the Great Depression, the most famous business cycle ever, impossible as the consensus opinion is that this episode was initiated by monetary policy. And while it may be fair to say that policymakers, industry, and the business press give monetary policy more credit for influencing real output in the short run than is warranted, most economists, academic or otherwise, believe that to some de-

gree money is non-neutral. Similarly, monetary policy is increasingly seen as the optimal short term policy lever of choice as fiscal policy's role as a discretionary policy instrument has been greatly diminished in recent years.

Money, however, need not be neutral in this class of models, and generating non-neutrality in a neoclassically-based model that is accessible to undergraduate macroeconomists is accomplished fairly easily. This paper presents such a model where non-neutral money is generated via a generic pricing distortion. Geared towards intermediate-level undergraduate macroeconomists, this framework is general enough to be able to motivate monetary non-neutrality in a variety of ways, ranging from nominal frictions (the method currently preferred among the macroeconomic community) to asymmetric information to liquidity effects. Thus, instructors have the opportunity to give their students with a broad view of recent macroeconomic thinking and research in a relatively short amount of time. Finally, in addition to delivering all of the standard cyclical results of a monetary expansion—higher output and prices, lower interest rates, higher investment, etc.—the model's expectations-intensive foundation is an ideal platform to consider the important role of expectations in policy effectiveness.

2. Neoclassical Modelling

The current universe of intermediate macroeconomics textbooks contain numerous treatments of the classical/neoclassical framework, ranging from Barro's (1997) fully-developed neoclassical model that features an explicit labor markets, investment and capital, and intertemporal choice to the more traditionally classical variants found in most texts. The framework presented here is general enough for use with most textbook treatments of the classical/neoclassical model; it is sufficiently compartmentalized to give instructors the option of eliminating various portions of the model depending on the desired level of complexity and sophistication.

Production in the neoclassical economy is accomplished by combining capital, K, and labor, L:

$$Y_t = f(K_{t-1}; L_t):$$

The dating convention on the capital stock avoids complications arising from being able to simultaneously alter both inputs to production. Capital accumulates according to:

$$K_t = (1 - \pm) K_{t-1} + I_t;$$

where ± is the depreciation rate of capital.

As is the case in the *IS-LM* model, the real interest rate is the key price in the neoclassical economy. Both consumption and investment demand, C^D, depend negatively on the real interest rate, r:

$$C_t^D = \underset{(i)}{C^D}(r_t; : : : ;)$$
$$I_t^D = \underset{(i)}{I^D}(r_t; : : : :)$$

Higher interest rates (1) create intertemporal substitution effects which decrease current consumption, and (2) raise the cost of capital which depress investment spending. In the above equations, the expression "::: " denotes the properties of the production function that affect productivity and wealth. Aggregate demand can thus be specified as follows:

$$Y_t^D = C_t^D + I_t^D = \underset{(i)}{Y^D}(r_t; : : :):$$

(Government spending is omitted but can be easily introduced.) Aggregate supply is also a function of the real interest rate:

$$Y_t^S = \underset{(+)}{Y^S}(r_t; : : : :)$$

Here, higher interest rates create intertemporal substitution effects which raises current work and thus production. "::: " again captures properties of the production function in addition to price distortions that will affect firms' production decisions, which will be discussed shortly.

Real money demand is a function of income and the nominal interest rate:

$$M_t^D = P_t \underset{(+)\ (i)}{\copyright}(Y_t; R_t):$$

The nominal interest rate is determined via an ex-ante Fisher equation:

$$R_t = r_t + ¼^e;$$

where $¼^e$ denotes the expected inflation rate. For simplicity, one can assume that inflationary expectations are primarily a function of the expected average growth rate in the money supply, which is assumed to be stable. The money supply, M^S,

is determined exogenously determined by the monetary authority, and is assumed to grow at a constant rate, θ, on average:

$$M_t^S = (1 + \theta) M_{t-1}^S.$$

An explicit labor market can also be included. Labor supply and demand can be derived from households' and firms' optimal labor decisions and are given by:

$$\begin{aligned} L_t^S &= L^S(\underset{(+)}{w_t/P_t}; \underset{(+)}{r_t}; \ldots); \\ L_t^D &= L^D(\underset{(-)}{w_t/P_t}; \ldots); \end{aligned}$$

where w/P is the real wage. The real interest rate influences labor supply via an intertemporal substitution effect. That is, higher real interest rate causes individuals to increase current work, which in turn decreases the real wage, all else being equal. This completes the basic textbook presentation of the neoclassical model.

3. Motivating Non-neutrality

Money is neutral in the above model. This, however, can be overcome in a variety of ways, including the asymmetric information theories developed by the neoclassical school (Friedman, 1968; Lucas, 1977); New Keynesian nominal frictions including menu costs (Mankiw, 1987), staggered price-setting (Taylor, 1979), and coordination failure (Ball and Romer, 1991; Cooper and John, 1993); liquidity effects (Christiano and Eichenbaum, 1995); and more complex $(s; S)$ pricing mechanisms (Caplin and Leahy, 1987; Dotsey et al., 1996). At present, the issue of monetary non-neutrality is predominantly associated with nominal frictions, and building such frictions into neoclassically-founded macroeconomic models has been going on for some time now. Indeed, there is even talk of a new "New Neoclassical synthesis" (Goodfriend and King, 1997).[1] To be consistent with the majority of active macroeconomic research—and because Barro's (1997) intermediate text already contains a fully developed asymmetric information setup—I focus on price stickiness as the mechanism underlying non-neutrality.

[1] Interestingly, the concept of nominal frictions considerably predates Keynes and his contemporaries. Hume, for example, wrote about sticky prices in the mid-1700s. Going beyond nominal frictions, a non-rigorous variant of the Neoclassical misperceptions model was developed by Mill. See Humphrey (1991) for more discussion.

The technical alterations of the neoclassical model is the same regardless of which nominal friction is used to motivate non-neutrality. As outlined by Mankiw (2000), individual firms are afforded some degree of pricing power, a deviation from the typical neoclassical assumption of perfectly competitive markets. Firms' pricing decisions are determined by the expected price level, P^e, and demand conditions, the mechanism behind the former being that a higher expected price level translates into higher costs working through labor and capital markets. The dual of this pricing mechanism is that production decisions will be influenced by deviations between the actual price level, P, and P^e.

Price expectations depend on prior information and structural knowledge of the economy, and will incorporate information concerning the size of the money stock (and perhaps growth therein) and variables that determine real money demand. Note that this pricing and expectations formation mechanism hews very closely to neoclassical theory; as previously stated, activity in the money market is still the most important determinant of prices and expectations therein. (Also note that a monetary pricing mechanism means that one need not to be concerned with prices or price expectations being directly influenced by activity in labor markets.) Finally, P^e can technically be set in a variety of ways: expectations can be rational, adaptive, a combination of both, or something else entirely.

In the aggregate, then, this translates into an increase in output whenever $P > P^e$. This gives us an aggregate supply relationship that depends positively on the price level:

$$Y_t^S = Y^S[\underset{(+)}{(P_t - P_t^e)}; \underset{(+)}{r_t}; \ldots]:$$

Thus if for some reason prices rise above their expected level, flexible price firms will expand output in response to unexpectedly higher relative prices. Under this setup, money and other nominal shocks will lead to changes in real output. If and when $P = P^e$, aggregate supply will be invariant to pricing conditions.

While the primary impetus for money to impact the real economy, i.e. the commodities market, is found on the supply side of the market, a sharp contrast to the *IS-LM* model and its derivatives, prices can also impact the demand side of the economy. An upward deviation in the price level from P^e, for example, can negatively impact both consumption (through both price and wealth effects) and investment spending. One could hence specify an aggregate demand relationship of the form:

$$Y_t^D = Y_t^D[\underset{(-)}{(P_t - P_t^e)}; \underset{(-)}{r_t}; \ldots]:$$

These demand side effects will be of second order importance, however. Unlike those firms that are unable to immediately adjust their prices, forward-looking households will be able to quickly adjust their behavior and outlook in response to a monetary shock. Coupled with the typically transient nature of shocks to monetary policy, one can ignore without loss of generality any direct price effects on the demand side of the economy resulting from monetary policy.

A graphic presentation of the full "friction augmented" neoclassical model, including the production technology and the labor market, is found in Figure 1. In the case of a change in monetary policy, it will be the case that both $(P - P^e)$ and r will change. In order to keep these price and interest rate effects separate, the aggregate supply curve Y^S is plotted twice, against both r and P. When aggregate supply is plotted against the price level (in the bottom center graph), a "demand-side" relationship of sorts is captured via the equation of exchange, $MV = PY$, where the velocity of money, V, is assumed to be constant or at least stable. This curve will shift in response to changes in the money supply, and will thus be beneficial in illustrating the effects of monetary policy.

The general nature of this model makes the incorporation of the frictions and asymmetries presented here into most, if not all textbook treatments of the classical/neoclassical model a fairly easy exercise. Introducing a nominal friction into the neoclassical model presented in the Barro text, for example, requires only adding a new argument to the existing aggregate supply function.[2] Similarly, this model may be presented as an extension to a basic classical model like the type presented in Farmer (2001) by eliminating the commodities market (top center) and replacing the equation of exchange with a Cambridge-k money demand function: $M = PY/k$. Additionally, capital and investment can be eliminated from this model without loss of generality, as can the labor market.

4. Effects of Monetary Policy

4.1. An Unanticipated Monetary Expansion

The short run effects of a shock to monetary policy are illustrated in Figure 2. The initial impact of this policy shift is seen first in the money market, bumping the money supply curve to M' and inducing an outward shift in the equation

[2] As previously mentioned, the Barro text includes a chapter detailing a "Lucas Island" type model that focuses on the expected to actual price ratio faced by households and firms, P_t^e/P_t. This discussion, however, is considerably more complicated than the one presented here.

of exchange curve. Those firms that have complete information and/or are able to fully adjust their prices will expand output in response to the fact that the economy-wide price level is higher than it is expected to be. If prices were able to fully and immediately adjust to the higher money supply, the new equilibrium price level will be $(P^{\alpha})^{LR}$. In the short run, however, the price level will be below $(P^{\alpha})^{LR}$, and it is ascertained by examining the secondary impacts of this monetary expansion on the commodities market.

The incomplete adjustment in the price level will induce an outward shift in the aggregate supply curve plotted in $(Y; r)$ space, which decreases the real interest rate. In turn, the decrease in the real interest rate induces a shift in the aggregate supply curve plotted in $(Y; P)$ space. On net, then, one observes the standard effects of expansionary monetary policy, namely an increase in real output and the price level and a decrease in interest rates. This decrease in the real interest rate will stimulate investment spending and current consumption, again the customary result.

Returning to the money market, the increase in output and the decrease in the nominal interest rate resulting from the decreased real rate will both act to increase money demand. This allows one to pin down the short run price level, $(P^{\alpha})^{0}$: In this situation, it is necessary to assume that the price level is more elastic with respect to the change in the money supply relative than it is to the (combined) change in income and the interest rate to generate the expected result that expansionary monetary policy is inflationary.

This increase in output can be tracked through the production function to illustrate the net impact on employment and the real wage. Since the capital stock enters the production function with a lag, one can initially ignore the effects of increased capital investment on production possibilities. Given the short run production technology, one can see that employment responds positively to expansionary monetary policy. One also knows that labor supply will decrease due to an intertemporal substitution effect arising from the decreased real interest rate. (Given the temporary nature of monetary policy effectiveness, one can safely assume this affect will be "small.") To clear the labor market, this decrease in labor supply must be more than offset by increased labor demand. This increase in labor demand arises from firms that are expanding output, that is, since firms want to expand output, but the capital shock and level of technology are fixed, firms' only recourse is to employ more labor. This results in a net increase in the real wage.[3]

[3] One may note the seemingly paradoxical result that the real wage is rising as the marginal

4.2. Long Run Adjustment

In this model, changes in the money supply only have temporary effects; money will be neutral in the long run. Specifically, when all firms in the economy have been able to fully adjust their prices to reflect the new quantity of money, the aggregate supply curve will not depend on pricing conditions. Graphically, this is demonstrated by a vertical aggregate supply relationship when graphed against the price level (see Figure 3), not unlike the "Long Run Aggregate Supply" curve associated with the Keynesian *AS/AD* model. Specifically, now that $P = (P^{\alpha})^{LR} = P^{e}$, the supply-side impact on the real interest rate and output are unwound, which returns money demand and labor supply to their original positions. Labor demand is similarly returned to its original level as firms scale back production plans in response to slowing sales, and employment and the real wage go back to their pre-policy levels. On net, the only long term impact of a higher money stock is a higher price level, as predicted by the quantity theory.

4.3. Anticipated Money

A related issue is expectations and the role they play in policy effectiveness. This has been one of the more important concepts in macroeconomic policy analysis ever since Lucas' (1981) initial work on the subject, and the model detailed here provides a useful platform to illustrate it. In this framework, only the surprise component of money is non-neutral, that is, the better firms are at forecasting monetary policy (and adjusting their prices accordingly), the less effective expansionary monetary policy will be in stimulating output. Graphically, this concept can be illustrated by the slope (elasticity) of the aggregate supply relationship. A more or less anticipated monetary expansion, for example, will come up against an aggregate supply relationship that is less elastic (steeper) with respect to the price level, thus resulting in a smaller increase in output, all else being equal. And with perfect foresight and sufficient lead time with regard to price adjustment, monetary policy will fail to create a price distortion and money will be neutral even in the short run. One can thus say accurate expectations hasten the long run.

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product of labor is falling, which would appear to violate one of the labor market clearing conditions. There is no cause for alarm here, however: in order to discuss firms changing and setting prices one must implicity give said firms some degree of market power. Thus, the real wage will be determined by the marginal product of labor and a procyclical markup.

5. Conclusion

The main weakness of the classical/neoclassical theories found in undergraduate textbooks is their inability to generate fluctuations in output in response to monetary policy. Thus when it comes time to discuss policy, instructors are forced to turn to the *IS-LM* model whether they want to or not. This *IS-LM* model and its derivatives, however, do not have a total monopoly on intermediate level policy analysis. Indeed, with some modifications on the supply side, neoclassical theory provides an very good substitute. To this end, this paper has presented an neoclassical model geared towards intermediate-level undergraduates that has been augmented with a generic pricing distortion for the purpose of policy analysis.

The model presented here can be adapted for use with virtually any textbook presentation of classical/neoclassical theory, and is consistent with most of mainstream theories on monetary non-neutrality proposed in the past 25 years. Furthermore, instructors can use this model to demonstrate easily the power expectations hold over monetary policy. Lastly, the model is able to deliver all of the standard monetary policy results in fully specified, general equilibrium setting. In short, instructors need not abandon the richness of neoclassical theory—microfoundations, dynamics, and forward looking decision making—in order to analyze monetary policy.

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FIGURE 1: Neoclassical Model with Non-neutral money

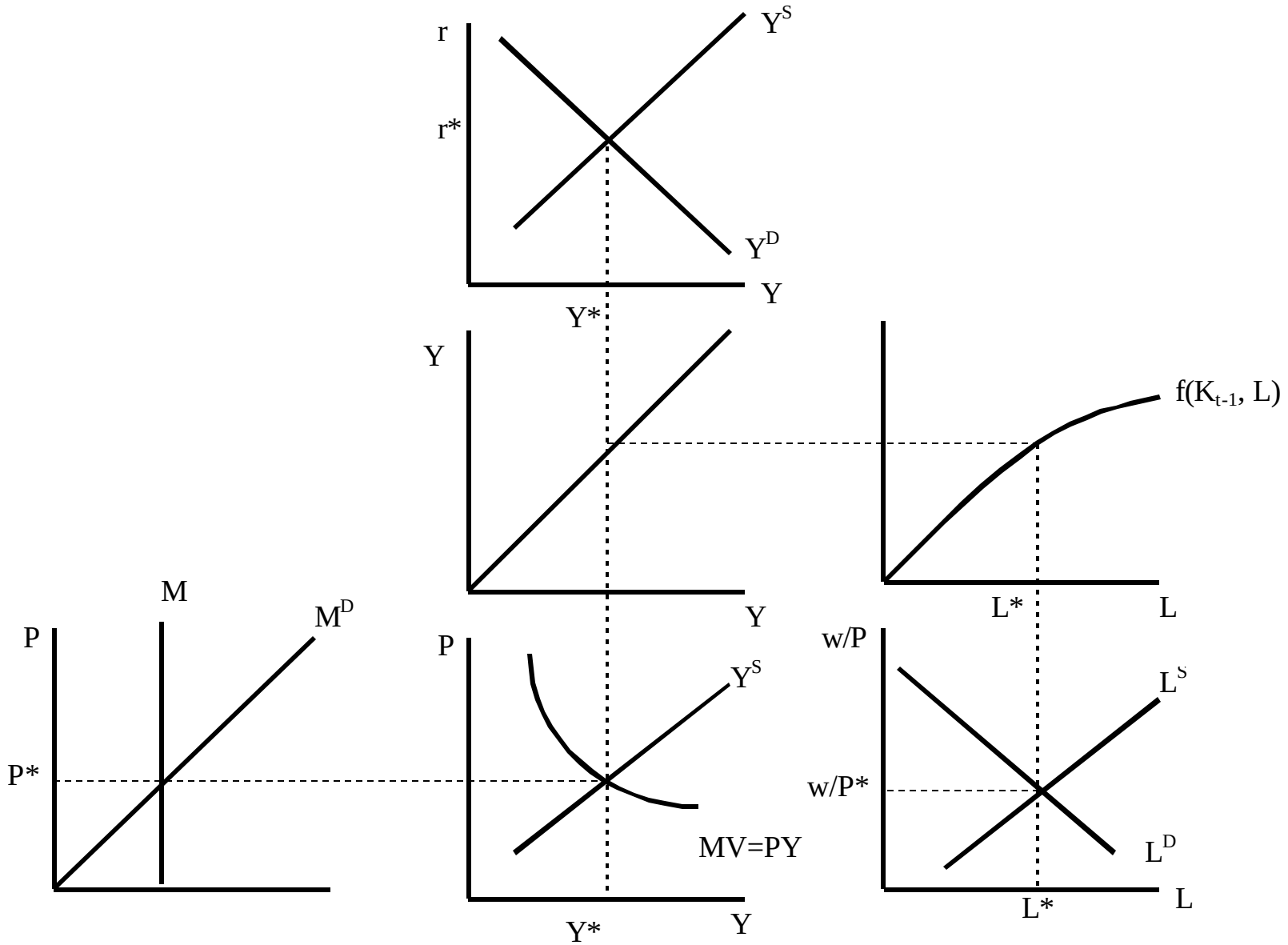

FIGURE 2: Surprise expansionary Monetary Policy in the Short Run

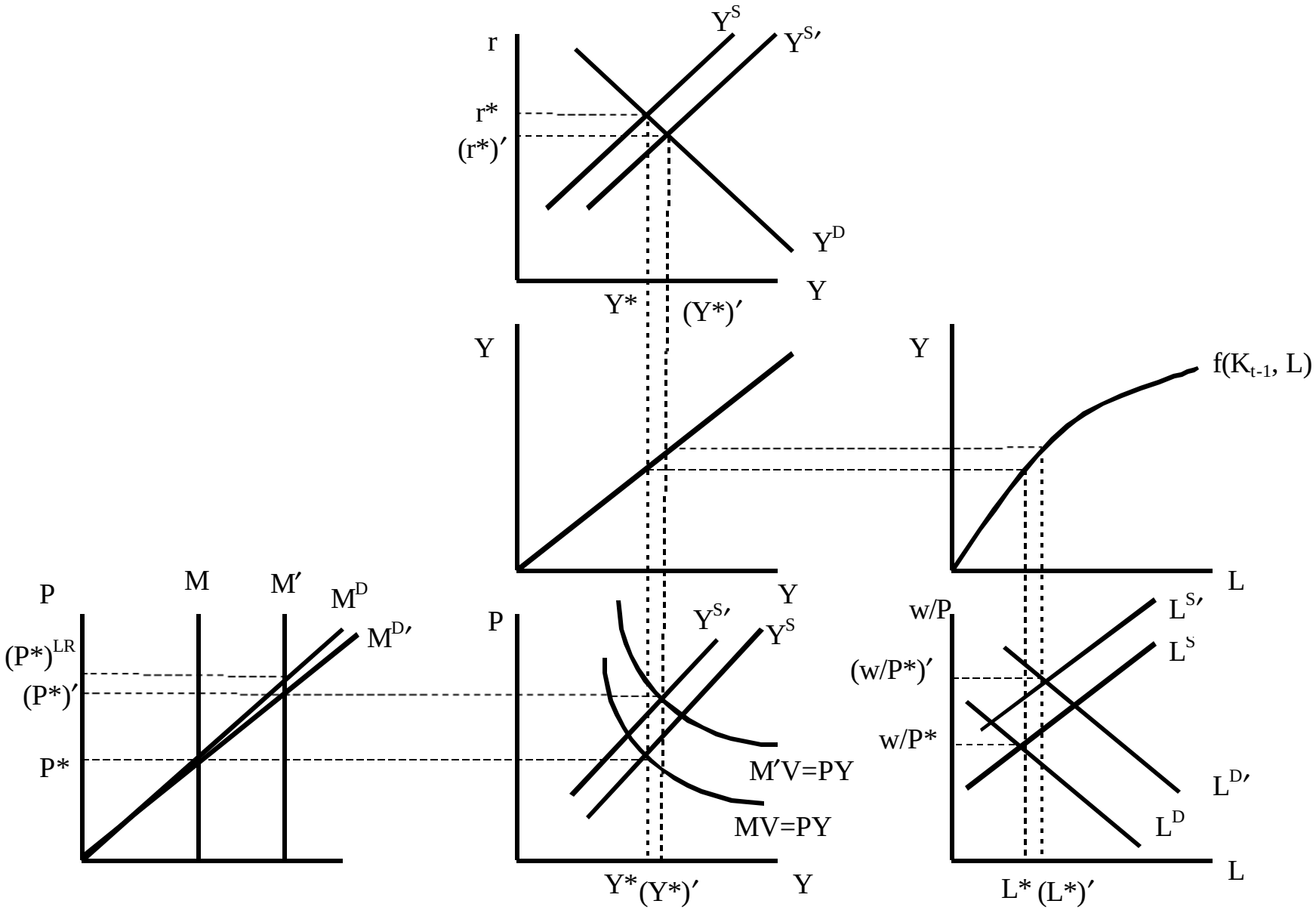

FIGURE 3: Anticipated Expansionary Policy/Long Run Effects