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Inter-Regional Factor Allocation in the Neo-Keynesian Macroeconomic Model

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Abstract

The standard neoclassical Two-Sector Model of inter-regional factor allocation says that a positive demand shock in one region starts immigration of both labour and capital, but that the adjustment of market prices eventually reproduces the inter-regional equilibrium. In the Neo-Keynesian macroeconomic framework of this paper, however, both the initial effects of the demand shock and the adjustment path to the new equilibrium are different. Under Perfect Foresight or under Rational Expectations the factors do not move at all, but under Adaptive Expectations the factors are induced to move in the short run. However, the factors move in opposite directions: a positive demand shock causes capital to immigrate and labour to emigrate. Inter-regional factor migration is an alternative to the intra-regional adaptation of people's expectations, which is the original rationale of the Adaptive Expectations Hypothesis.

Key words: Adaptive Expectations Hypothesis (AEH), factor migration, spatial resource allocation
JEL classification: F41, R23

1 Introduction

Spatial allocation of economic resources is a major concern of the neoclassical approach to regional growth. A leading intuition of the approach is that the market mechanism supports a stable and efficient spatial equilibrium where no benefits can be driven from relocation. Any exogenously originated inter-regional differences in factor rewards get always re-equalized by the market.

The One-Sector Model and the Two-Sector Model are among the most common textbook analyses of factor allocation (McCann, 2001, pp. 208-221). Both derive from the classic general equilibrium framework. The One-Sector Model postulates that variable factor proportions may cause short-run inter-regional differences in the *marginal products* of capital and thus in the factor rewards. This induces factor migration to opposite directions so that the rewards and the capital/labour ratios get equalised in the long run. The Two-Sector Model assumes regional differences in production implying that it is the *marginal revenue products* that determine the factor rewards, and that both factors may occasionally be attracted to flow into the same direction. The insight still is that the market mechanism yields an efficient solution, where the factor productivities are re-equalized.

The rationale of the Two-Sector Model rests on the two-stage adjustment of commodity prices. First, a positive demand shock makes the prices rise, which improves the marginal revenue products of the factors thus causing immigration of capital and labour. Second, as the immigration of factors consequently increases production and thus supply in the market, the prices adjust downwards. As this occurs reversely in the rest of the economy, the market mechanism eventually eliminates the original demand shock, and the economy settles to a new stable and efficient equilibrium with equal factor rewards everywhere. (McCann, 2001, pp. 214-217.)

This paper reconsiders the message of the Two-Sector Model of regional factor allocation in a Neo-Keynesian macroeconomic framework. The focus is on the simultaneous market adjustment in the

goods and factor markets. The framework is set up in Section 2. The classical long-term adjustment mechanism under Perfect Foresight (or Rational Expectations) and the short-term adjustment mechanism under Adaptive Expectations are studied in Section 3. Section 4 concludes.

2 The framework

The framework is an elaboration of the seminal Neo-Keynesian macroeconomic framework (Laurila, 2004). The supply side in the regional goods market is determined by the production function and by the factor market conditions. The production function for one particular region is

$$(1) \quad q = f(L, K),$$

where L denotes regional labour, measured in terms of labour time, and K denotes the regional capital stock. The standard assumptions concerning the production function are made, namely constant returns to scale and $f_l, f_k > 0, f_{ll}, f_{kk} < 0, f_{lk} = f_{kl} > 0$, where the subscripts refer to first and second partial derivatives of the function (1).

Labour demand in the regional labour market derives from profit maximisation of the firm sector. The labour demand function is

$$(2) \quad w = p f_l,$$

written in terms of nominal wages. Function (2) says that the demand for labour equals the marginal revenue product of labour. The labour demand curve has a negative slope in L - w space. Labour supply, derived from people's optimal time use decisions, reads

$$(3) \quad w = pg(L),$$

where the right-hand-side tells the marginal opportunity cost of labour time. Since $g' > 0$ by assumption, the labour supply curve is upward sloping in $L-w$ space.

In the regional capital market, the demand for capital derived from profit maximisation reads

$$(4) \quad p = r/f_2$$

written in terms of prices and manipulated from the regular demand function, which says that the market rent for capital equals its marginal revenue product. By (4), the capital demand curve has a positive slope in the $K-p$ space. The supply of capital derives from people's inter-temporal optimisation. Assuming that the supply of the capital inputs is positively correlated to the real factor rewards, the supply function can be written implicitly as

$$(5) \quad p = r/\varphi(K),$$

where $\varphi(K)$ denotes the opportunity cost of capital and $\varphi' > 0$. Thus, the capital supply curve is downward sloping in $K-p$ space.

The aggregate demand conditions of the regional economy are determined by the IS-LM model.

The equilibrium of the real side of the economy, the IS curve, is given by

$$(6) \quad q = c(q) + i(r),$$

where c denotes consumption and i denotes investment. The inter-regional trade of goods is ignored and the budget of the local public sector is not spelled out. Since $c' > 0$ and $i' < 0$ by assumption, the IS curve is declining in q - r space. The LM curve is given by the money market equation

$$(7) \quad m/p = l(q, r),$$

where the supply of real money equals the demand of liquid money, reasoned by transaction use depending on production q and inter-temporal use depending on the interest rate r . The assumptions $l_1 > 0$ and $l_2 < 0$ imply that the LM curve slopes upwards in q - r space.

The functions (1) – (5) determine the aggregate supply (AS curve) and equations (6) and (7) give the aggregate demand (AD curve) in the regional goods market. The AS curve is vertical unless the price changes are anticipated asymmetrically by the demanders and the suppliers of the factors. Possible differences in the anticipations are treated below in terms of graphics and a formal presentation of the expectation hypotheses is omitted. The AD curve has a negative slope in q - p space. Positive demand shocks shift the IS curve and thus the AD curve outwards and vice versa.

3 Price adjustment and factor movements in the Neo-Keynesian model

3.1 The classical long-term effect

Reconsider the price adjustment argument of the Two-Sector Model in the present framework. For the sake of simplicity, assume that the considered region is of atomistic size so that the factor rewards outside the region are taken as given. Assume also that the factor rewards are not transportable between regions. Apply the Perfect Foresight Hypothesis (or the Rational Expectations Hypothesis, which is equivalent in terms of graphics) to describe the factor market responses to the changes in commodity prices.

Figure 1 presents the market adjustment. The Figure consists of two sets of quadrants. Panel (i) includes the labour market, the production function, the goods market and the real wage, listed clockwise from northeast. Panel (ii) includes the capital market, the production function, the IS-LM framework, and the real interest rate, listed clockwise from northeast.

(Figure 1 here)

In Figure 1, the initial inter-regional equilibrium is given by the market price set (p_0, w_0, r_0) . Thus, the real wage is $\omega^* = (w/p)^* = f_1^*$ and the real interest rate is $\rho = (r/p)^* = f_2^*$ everywhere. The regional employment is L_0 and the capital stock is K_0 implying that production is q_0 . Suppose that there emerges an exogenous demand shock, shown by an outward shift of the IS curve from IS_0 to IS_1 in Panel (ii) and the consequent shift of the AD curve from AD_0 to AD_1 in Panel (i) in Figure 1.

As is argued by the Two-Sector Model, the increase in local commodity demand causes the prices to rise from p_0 to p_1 . In the classic regime of the model this causes labour demand to increase from D^L_0 to D^L_1 and makes also labour supply shift back from S^L_0 to S^L_1 in Panel (i) of Figure 1. Nominal wages rise from w_0 to w_1 , and the labour market equilibrium shifts vertically from e_0 to e_1 . In Panel (ii), the IS curve shifts from IS_0 to IS_1 and the LM curve shifts inwards from LM_0 to LM_1 because of the rise in the price level from p_0 to p_1 . The nominal interest rate rises from r_0 to r_1 so that the real interest rate remains unchanged at ρ^* . Therefore, the demand for capital shifts backwards from D^K_0 to D^K_1 , and the supply of capital shifts outwards from S^K_0 to S^K_1 . The capital market equilibrium shifts vertically from ε_0 to ε_1 .

In Figure 1, real wages, employment and production remain unchanged at ω^* , L_0 and q_0 , respectively, and so do real interest rates, capital use and production at ρ^* , K_0 and q_0 , respectively.

The conclusion is that the demand shock has no real effects in the regional economy. In particular, there are no effects on factor migration. This conclusion seems to contradict the Two-Sector Model argument, which postulates that factor migration should be induced. It must be noted, though, that the classic conclusion is a long-term result in nature, and that the Two-Sector Model literally says that the migration effects are short-term ones in nature.

3.2 The short-term adjustment path

Consider the short-term adjustment to the classical long-term equilibrium explored above. In spite of its out-datedness, apply the Adaptive Expectations Hypothesis to describe the adjustment path. In Figure 2 below, the short-term adjustment is illustrated by assuming that factor demand and factor supply respond asymmetrically to the exogenous price shock. In particular, the firm sector is assumed to be perfectly foresighted, while the household sector is assumed to lack such rationality.

(Figure 2 here)

Start again from the positive demand shock implying that the IS curve shifts from IS_0 to IS_1 in Panel (ii) and the AD curve shifts from AD_0 to AD_1 in Panel (i) of Figure 2. In Panel (i), the perfectly foresighted firms anticipate that the price level rises according to the long-term aggregate supply curve AS^{LT} from p_0 to p_1 . Thus, the demand for labour shifts from D^L_0 to D^L_1 . Likewise, in Panel (ii), as the firms correctly anticipate that the interest rate rises from r_0 to r_1 according to the long-term LM curve LM^{LT} , the demand for capital shifts backwards from D^K_0 to D^K_1 .

In the very short term, the price effect surprises the people as factor suppliers so that the supply conditions remain unchanged in the factor markets. The momentary equilibrium in the labour market shifts from e_0 to e' along S^L_0 in Panel (i) and that in the capital market shifts from ε_0 to ε' in Panel (ii) of Figure 2. Momentarily, employment increases from L_0 to L' and capital use decreases

from K_0 to K' . On impact, the production function shifts inwards in Panel (i) and outwards in Panel (ii). The momentary equilibrium in the labour market in Panel (i) implies that the price level is p' , the nominal wage is w' and the real wage is ω' , which is lower than ω^* . The respective equilibrium in the capital market in Panel (ii) means that the nominal interest rate is r' and that the real interest rate is ρ' , which is higher than ρ^* . Production has increased from q_0 to q' in both Panels.

There are two possible paths for market adjustment, the *intra-regional* path and the *inter-regional* path. The intra-regional path is reasoned by the Adaptive Expectations Hypothesis saying that as people come aware of the direction of the price change they gradually correct their actions towards that direction. In the labour market people respond to the decreased real wage by reducing their labour supply. The momentary equilibrium e' thus starts to move along D^L_1 towards e_1 in Panel (i) of Figure 2. Likewise, in the capital market in Panel (ii), people respond to higher real interest rates by increasing their supply of capital so that the momentary equilibrium moves from ε' towards ε_1 along D^K_1 . The factor uses also move back towards their initial stages, and so do the graphs of the production functions in the Panels (i) and (ii). The classical long-term equilibrium is thus eventually reached after the adjustment path has been gone through.

Second, there is the inter-regional path of market adjustment given by the possibility of free factor mobility. Return to the momentary equilibrium, where people start to become aware of the price implications of the demand shock. In the labour market, at point e' in Panel (i) of Figure 2, people see that the local real wage ω' has fallen below ω^* . Since the real wage in the rest of the economy remains at ω^* and supposing that people are aware of that, motives for emigration arise. Observing at p_1 , which is the price level that makes local labour demand and labour supply commensurable, the induced amount of emigration is $L_1 - L_0$, measured in terms of labour time units. In the capital market in Panel (ii) the short-term equilibrium at ε' says that the local real interest rate has improved from that in the rest of the economy, $\rho' > \rho^*$. Taken that capital is mobile, the difference

clearly attracts capital to immigrate from the rest of the economy. The consequent inflow of capital amounts to $K_0 - K_1$ observed at the relevant nominal interest rate r_1 .

The induced emigration of labour $L_1 - L_0$ and the induced inflow of capital $K_0 - K_1$ immediately reproduce the long-term classical equilibrium, where employment is L_0 , capital use is K_0 and production is q_0 . The real wages and real interest rates are again equalised everywhere to ω^* and ρ^* , respectively.

4 Conclusions

The analysis of regional factor allocation in the Neo-Keynesian Model makes three contributions. First, as compared to the Two-Sector Model, the present model makes clear distinction between the long term and the short term, and it is very explicit in the treatment of the short-term adjustment. On the long term, exogenous demand shocks have no real effects on the regional economy. The long-term neutrality is explained by the market adjustment, which in turn may include short-term effects on migration. Short-term effects arise if the Adaptive Expectations Hypothesis is applied in stead of the Perfect Foresight Hypothesis or the Rational Expectations Hypothesis.

Second, the analysis shows that factor migration substitutes the original idea of the Adaptive Expectations Hypothesis in describing the adjustment path towards the long-term equilibrium. A *inter-regional* explanation concerning factor migration induced by differences in the factor rewards is introduced as an alternative to the normal *intra-regional* error-correction argument concerning the gradual adaptation of the regional factor suppliers to the actual price effects. Both mechanisms may take place at the same time thus replacing each another. The final shares of the mechanisms and thus the amounts of factor migration depend on the relative sensitivities of the two mechanisms.

This remains an empirical question, but in any case the fresh interpretation emphasises the importance of the analysis of the short-term adjustment path.

Third, while the analysis supports the Two-Sector Model of regional factor allocation concerning the long-term capability of the market mechanism to handle exogenous demand shocks, the main result concerning the short-term adjustment is that the shocks do not make the two factors migrate in the same direction as the Two-Sector Model postulates. In the present model, the factors migrate in opposite directions. In particular, a positive demand shock motivates emigration rather than immigration of labour. The differences in the short-term effects are because of the asymmetric anticipation of the price effects. Due to the asymmetry, a positive price shock causes a momentary fall in the real wages thus inducing emigration of labour and a momentary rise in the real interest rate thus inducing immigration of capital.

References:

- Barro, R. and X. Sala-i-Martin (2004): *Economic Growth*. 2nd ed. Cambridge (Ma.): The MIT Press.
- Brown, C. and P. Jackson (1978): *Public Sector Economics*. Oxford: Martin Robertson & C. Ltd.
- Heijdra, B. and F. van der Ploeg (2002): *Foundations of Modern Macroeconomics*. Oxford: Oxford University Press.
- Isard, W. (1975): *Introduction to Regional Science*. Englewood Cliffs: Prentice-Hall Inc.
- Krugman, P. and M. Obstfeld (2003): *International Economics. Theory and Policy*. 6th ed. Boston: Addison-Wesley.
- Laurila, H. (2004): A General Equilibrium Elaboration of the Classic Model of Migration. *Tampere Economic Working Papers, Net Series*, No. 36, December 2004.
- McCann, P. (2001): *Urban and Regional Economics*. Oxford: Oxford University Press.

Figure 1: Classical macroeconomic effects of a demand shock

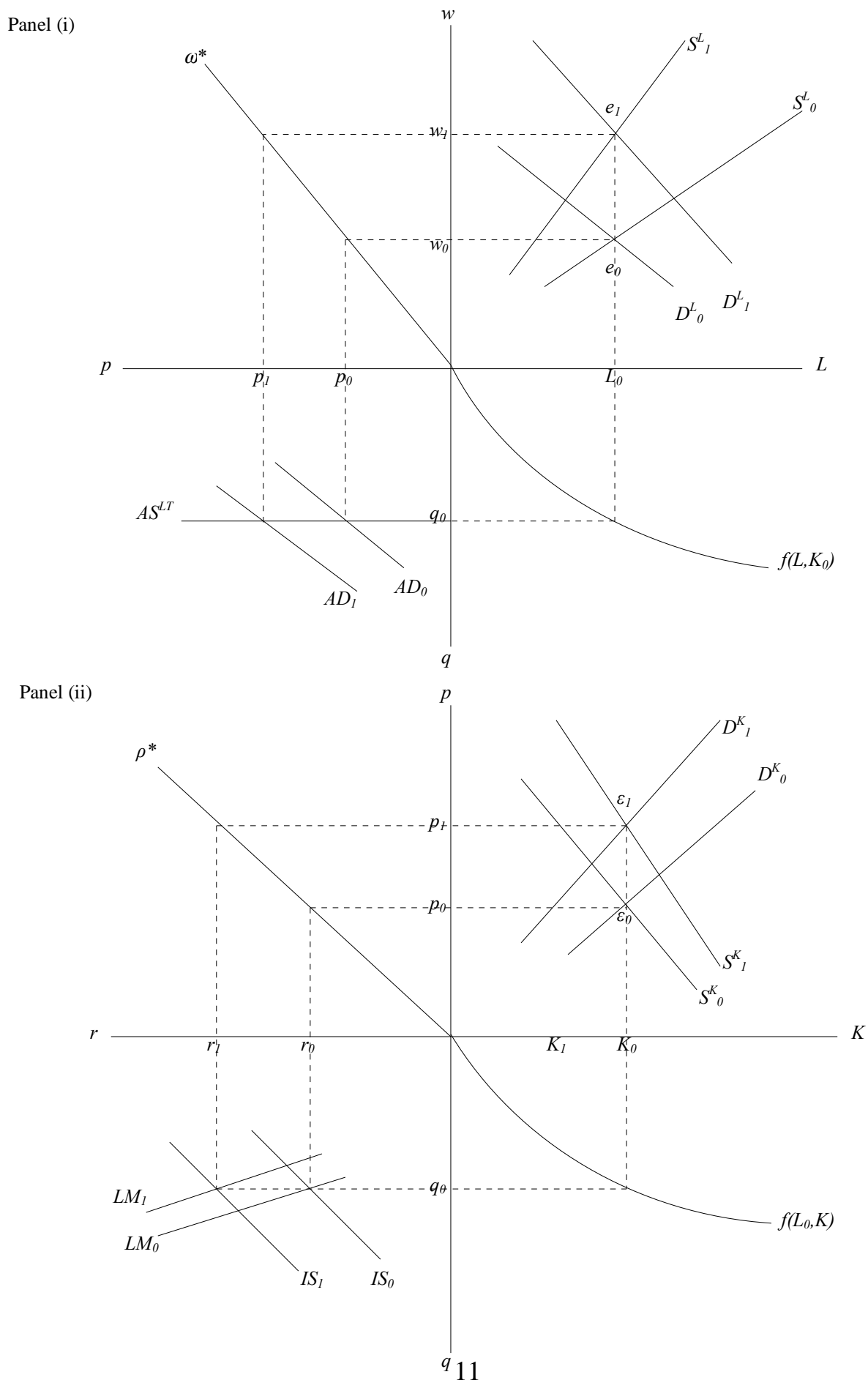
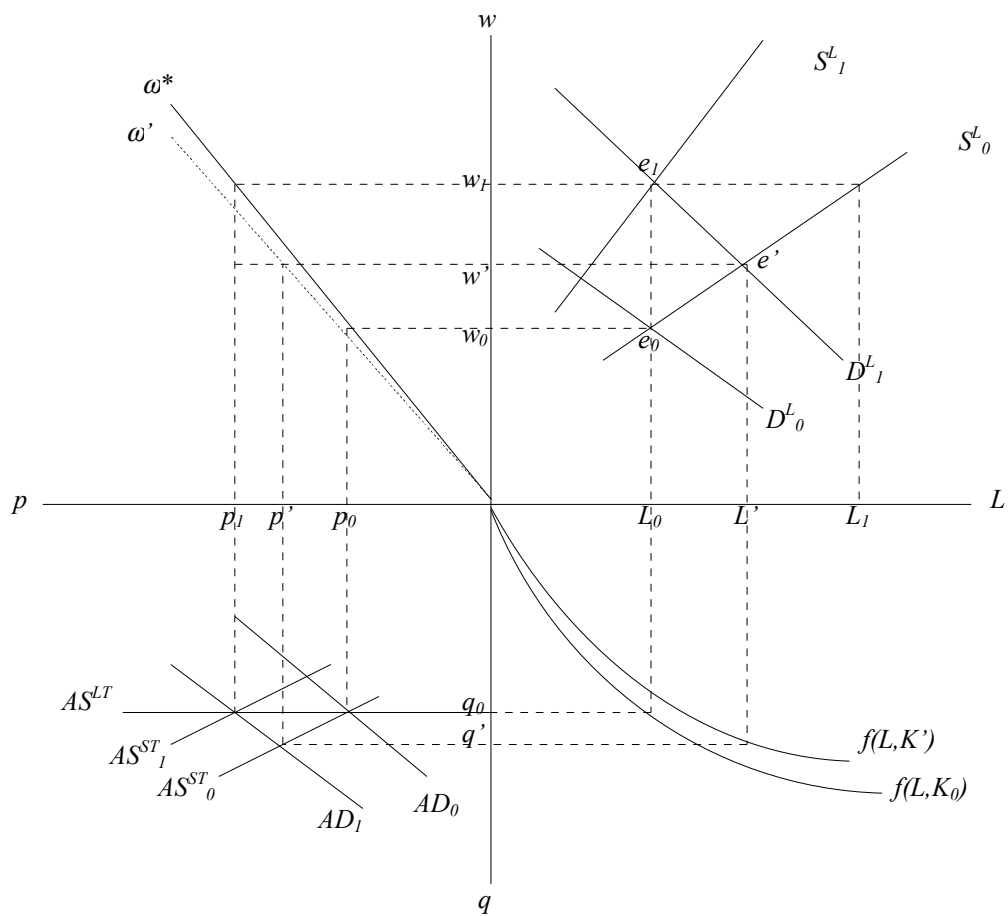


Figure 2: Short-term effects of a demand shock on factor movements

Panel (i)



Panel (ii)

