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International Trade and Domestic Distortions: Modelling the Transition Process*

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Abstract

According to the standard view, when full competition prevails in product, labour, and capital markets, positive or negative external trade shocks may be accommodated by the migration of jobs between sectors; the negative impact on some households' income of lower nominal wages will be more than offset by lower prices of imported final goods. Unemployment, if any, will be temporary, unless labour market rigidities prevent the necessary adjustment. We argue that trade shocks trigger a process of creative destruction that necessarily causes distortions in the structure of productive capacity and hence market disequilibria. Therefore, the structural change that follows trade shocks can no longer be analysed within an equilibrium framework. The transition following a shock may be characterized by increasing imbalances, and create scope for policy intervention. The model presented in this paper, which focuses on the time dimension of production and market imbalances, allows clarifying the debate.

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1 Introduction

Developed economies exposed to competition from large emerging countries such as China or India experience significant increases of imports, relocation, outsourcing and jobs' destruction in manufacturing sectors but also in value-added services, which are becoming tradable. Emerging countries are exposed to a symmetric shock: an increase of exports and FDI that implies deep changes in industrial organisation and hurts the workers. International order is deeply disturbed. This feeds a recurrent debate between the tenants of the free market and those who plead for increasing protection.

According to the elementary theory of international trade, which rests on the law of comparative advantages, an increase of exchanges between countries is systematically beneficial to all partners. Importing new goods and services, even when these goods were previously domestically produced, creates new opportunities and allows using productive resources in a different and more efficient way. The loss of manufacturing jobs due to the growing import penetration is generally offset by the job creation effect of growing exports. Penetrating international markets by exporting new goods and services purchased by the consumers of more advanced countries allows emerging countries to take advantage of larger productivity gains associated with export sectors (Lucas 1993). International trade is thus a positive sum game and cannot be considered as responsible of increasing unemployment, waste of resources, and lower growth in any country.

However, old as well as more recent analyses demonstrated the possibility of losses for some participants to the exchange. These losses would be essentially due to differences in productivity gains among countries, which result in differences in real income (Hicks 1953, Krugman 1985, Gomory and Baumol 2000, Samuelson 2004). These models deal with the welfare effects for a country when domestic production is taken over by its trading partner, generally a less advanced country. Krugman (1985) argues that while technical progress in the more advanced country is always beneficial to both countries, progress in the poorest country can, depending on circumstances, be harmful for the more advanced one. Similarly, Gomory and Baumol (2000) show that with increasing returns, and for sufficiently close levels of income in the two countries, trade and relocation will harm the rich country. There are many possible outcomes ranked in terms of welfare. Thus when a new outcome corresponding to a different distribution of industries among countries prevails, there will be winners and losers.

This paper is not concerned by the final welfare effects of changing trading patterns. We focus on the complementary issue of the adjustment that has to take place following the trade shock. One cannot deny that changes

in international trade entail social and distributional costs. "Trade can generate sizable benefits only by restructuring economies – that is the essence of specialization according to comparative advantage – and in the real world restructuring does not happen without someone bearing costs. The flip side of the gains from trade is the losses that have to be incurred by adversely affected workers and enterprises(...). Simply put: no pain, no gain. It makes little sense to pretend otherwise" (Rodrik, 1998 p. 5). Thus it is not enough to focus on the distribution of gains between countries or within countries (among different skills, or between wages and profits). In the following we will argue forcefully restructuring is an intrinsic feature of globalization and relocation processes; in fact, increasing openness is a form of structural change and hence analytically equivalent to technical progress; as such, it entails the destruction of the existing productive capacity (and of the corresponding jobs), and the construction of something new to replace it. Thus, distortions are not an impediment to a smooth transition to the new equilibrium, as argued by the tenants of free market paradigm; they are an *intrinsic and unavoidable feature* of the structural change process. We push Rodrik's argument even farther, by arguing that this process of restructuring needs not to be successful: the *ex ante* benefits from increased openness may *ex post* fail to materialise, if something goes wrong with the co-ordination process. Thus, the process of restructuring needs not to be successful.

Our medium-run analysis on the conditions for the success of the transition will be, inevitably, concerned with short-term effects on employment and wages and hence with policy conclusions. In fact, we will conclude that the viability of the transition, and the recovery of coordination crucially hinge upon the right mix of institutional and policy factors, notably in what concerns access to credit.

The remainder of this paper is structured as follows: section 2 contrasting the standard neoclassical framework with an evolutionary one, is an attempt to identify which domestic distortions matter in a country facing a change in conditions of international competition. Sections 3 and 4 then propose a model that allows both reproducing neoclassical results and introducing an analytical framework suited to deal with structural change. By using the model and simulating out-of-equilibrium paths, section 5 shows how real domestic distortions influence the evolution of the economy, and hence why and how international trade matters. Section 6 concludes.

2 Which Domestic Distortions Matter?

Changes in international trade will result in mutual gains if there is no obstacle to prevent the redistribution of productive resources among sectors that allows the convergence toward the full employment equilibrium. Thus, the low-wage country will be able to use an affluent amount of labour in the production of new goods. The high-wage country will be able to increase productivity, by reallocating its labour force in the value-added services and high-tech sectors, where it has a comparative advantage. It will also be able to shift some workers from manufacturing to service jobs even if the latter require lower skill and hence involve lower nominal wages (compensated by the decrease of prices of imported goods).

Within the standard analytical framework these considerations lead to focus on the role played by wage adjustments and distortions associated with them. For the gains from trade and relocation to occur it is essential that no domestic distortion prevents the necessary adjustment (i.e. the convergence towards the full employment equilibrium). Changes in fundamentals (technology and preferences) must be accommodated by relative prices (in particular wages). In this case, relocation only corresponds to a better allocation of resources at the international level without harmful consequences on employment. Increasing imports will be matched by increasing exports.

The only obstacle that would prevent from capturing the gains from trade is the downward rigidity of wages paid to low-skilled workers. On the one hand, this stickiness would cause unemployment of low-skilled workers. On the other hand, the flows of international trade can be distorted. As Brecher (1974) put it, if minimum wage applies in the high-wage and capital abundant country, the labour intensive sector both fires too many workers and sets free a too large amount of capital. As a consequence, both exports of capital-intensive goods and imports of labour-intensive goods grow beyond what is considered their optimal size. This view is coherent with policies that focus on supply conditions with the objectives of increasing competitive advantages for an economy with respect to its external competitors. Reducing wage differentials, improving labour market flexibility, reducing taxes seem to be the only viable policies aimed at avoiding domestic distortions and their effects on the structure of international trade, thus favouring full employment. This view is partial, focusing on the functioning of the labour market and ignoring the systemic nature of the process of change and its time dimension. There is no reference to the creation of resources. Price and wage distortions, when occurring, only affect the rate of utilisation of productive resources (labour), and result in their under-utilisation. This is the reason why policy makers have o correct these distortions by reducing

direct and indirect labour costs.

This paper takes the view that distortions are intrinsically built in structural change processes, as the one stirred by globalisation. As a matter of fact, economies hurt by changes in international trade are concerned with other distortions that those which are created by the wage stickiness. Changes in international trade go hand-to-hand with the breaking-up in the pre-existing industrial and spatial structure of productive capacity, which results in unavoidable disequilibria between supply and demand of final goods, all along the transition towards the new adapted structure of the economy. Thus, the supply side, and in particular investment, become crucial for an analysis of the transition to a new steady state. As the problem does not consist in the reallocation of existing resources but in the creation of a new productive capacity, it is pointless (and may be harmful) to try to bypass the transition and the associate turbulence by eliminating the price distortions. Policy should rather accompany the process of change, progressively removing or softening the constraint faced by the economy.

Indeed, as a consequence of trade liberalization, imports are substituted for goods locally produced, while local exporters have not automatically the necessary supply capacity to expand. Thus, "liberalization seems to result in labour temporarily going from low-productivity protected sectors to zero-productivity unemployment" (Stiglitz and Charlton 2006 p. 26). This is true both for developing and developed countries. This leads to a reduction of income, and hence in the demand for final output, which will be more or less pronounced whether according to the level of social insurances. At the opposite of the conclusion of standard analysis, a high level of social protection can help to avoid global damages associated with a cumulative process of depression.

In this perspective, international trade as well as foreign direct investment matter, but not only with respect to initial endowments or existing externalities. In fact, for an open economy, balanced growth results from harmonisation of external and internal demand with the productive capacity. Trade and openness may be very important factors both in increasing the long-run growth potential, and in smoothing fluctuations due to country specific shocks; but this positive role is fulfilled only if the economy has internal resources – the reference is mainly to productive capacity, but also to a sufficient level of revenues – to match the increase in demand and to keep the balance that is necessary to successfully complete a transition process.

Thus, openness and the emergence of new countries do not create difficulties per se. Market disequilibria and distortions in the productive capacity that necessarily emerge both in the emerging and developed countries call for local co-ordination of economic activities, which cannot amount to re-

ducing production costs in the hope of re-establishing competitiveness. Coordination should consist in creating the conditions for firms to deal with these real distortions, which are the unavoidable consequence of structural change.

Summing-up, what is at stake is not to prevent real domestic distortions that are inherent to the process of change, but how to smooth them thanks to appropriate policies. Thus we need a model that puts into light these distortions and allows identifying the required remedies.

3 The Benchmark Model

We consider a model with one country and two goods. This model does not directly address issues related to growth and trade relationships, but it is an attempt to analyze how an external shock due to an increase in competitiveness of a foreign country affect the composition of goods produced in both countries, and hence global performance.

Our economy is comprised of N firms, that are divided in the production of a basic (b) and an advanced (a) good. This production is sold to a representative domestic household, who supplies labour inelastically, and to a foreign household. The utility of the domestic household also includes an imported good, and is written as follows:

$$\begin{aligned} \max\ u &= X_a^{\gamma\delta} X_b^{\gamma(1-\delta)} Z^{1-\gamma} \\ s.t. \quad R &= p_a X_a + p_b X_b + qZ \end{aligned}$$

where p_a, p_b and q are the prices of the advanced, basic and imported good, respectively, and R are total revenues of the household. The foreign household demands W_j ($j = a, b$), that we treat as exogenous. As a consequence, the value of total demand, for the two goods is given by:

$$\begin{aligned} p_a X_a &= \gamma\delta R + W_a \\ p_b X_b &= \gamma(1-\delta) R + W_b \end{aligned} \tag{1}$$

Demand for the imported good, $qZ = (1-\gamma)R$, does not concern us. The α and β (with $\alpha + \beta \equiv N$) firms in the two sectors compete in quantities, à la Cournot. We further assume that workers can work in any of the two sectors (i.e., that $w_a = w_b = w$), and that A_j is the number of workers per unit produced in each sector $j = a, b$ (we assume constant returns to scale).

The standard, solution of the problem gives

$$x_a = \frac{(\alpha-1)(\gamma\delta R + W_a)}{\alpha^2 A_a w}, \quad p_a = \frac{\alpha w A_a}{\alpha - 1}, \quad \pi_\alpha = \frac{(\gamma\delta R + W_a)}{\alpha^2} \tag{2a}$$

$$x_b = \frac{(\beta-1)(\gamma(1-\delta)R + W_b)}{\beta^2 A_b w}, \quad p_b = \frac{\beta w A_b}{\beta - 1}, \quad \pi_b = \frac{\gamma(1-\delta)R + W_b}{\beta^2} \tag{2b}$$

where of course we assume symmetry ($x_a = X_a/\alpha$, and $x_b = X_b/\beta$).

To close the model, we finally assume that profits are distributed to the domestic household, so that household income R is equivalent to the revenues from sales of the two goods produced at home:

$$R = p_a X_a + p_b X_b \tag{3}$$

From eqs. 3 and 1 we can obtain

$$R = \gamma\delta R + \gamma(1-\delta)R + W = \frac{W}{1-\gamma}$$

where $W \equiv W_a + W_b$. The total revenues of the system are a function of external wealth. As a consequence, from eq. 1 we can define the value of production in the two sectors as

$$\xi_a = p_a X_a = \frac{\gamma\delta}{1-\gamma} W + W_a = \left(\frac{\gamma\delta}{1-\gamma} W_b + \frac{\gamma\delta + (1-\gamma)}{1-\gamma} W_a \right)$$

$$\xi_b = p_b X_b = \frac{\gamma(1-\delta)}{1-\gamma} W + W_b = \left(\frac{1-\gamma\delta}{1-\gamma} W_b + \frac{\gamma(1-\delta)}{1-\gamma} W_a \right)$$

Notice that external demand of both goods enters into the two demand curves. This happens through the revenues effect

3.1 Equilibrium

The equilibrium relies on two conditions.

- The first is the equilibrium in the labour market, requiring that the quantity of labour L, inelastically supplied, be equal to labour demand:

$$L = A_b X_b + A_a X_a = \frac{A_b \xi_b}{p_b} + \frac{A_a \xi_a}{p_a} \tag{4}$$

- The second equilibrium condition is the equality of profits across sectors, which implies that no firm will have incentive to switch. Rewriting eqs. 2 as

$$x_a = \frac{\alpha-1}{\alpha^2 A_a w}\xi_a, \qquad p_a = \frac{\alpha w A_a}{\alpha-1}, \qquad \pi_\alpha = \frac{\xi_a}{\alpha^2} \tag{5a}$$

$$x_b = \frac{\beta-1}{\beta^2 A_b w}\xi_b, \qquad p_b = \frac{\beta w A_b}{\beta-1}, \qquad \pi_b = \frac{\xi_b}{\beta^2}, \tag{5b}$$

  the condition $\pi_a = \pi_b$ yields

$$\frac{\xi_a}{\alpha^2} = \frac{\xi_b}{\beta^2} \tag{6}$$

Putting together eqs. 4 and 6, using the price equations of eq. 5 and the fact that $\beta = N - \alpha$, equilibrium is defined by the solution to the following system:

$$\frac{\sqrt{\xi_a}}{\alpha} = \frac{\sqrt{\xi_b}}{N-\alpha} \tag{7a}$$

$$wL = \frac{(N-\alpha-1)\xi_b}{N-\alpha} + \frac{(\alpha-1)\xi_a}{\alpha}, \tag{7b}$$

where the unknowns are α and w. The system can be solved recursively to obtain α^* and w^*

$$\alpha^* = N\frac{\sqrt{\xi_a}}{\sqrt{\xi_b}+\sqrt{\xi_a}}. \tag{8a}$$

$$w = \frac{(\xi_b+\xi_a)(N-1)\sqrt{\xi_b\xi_a} - 2\xi_b\xi_a}{LN\sqrt{\xi_b\xi_a}} \tag{8b}$$

It is interesting to notice that only external demand and the number of firms help determine α^* and w^*. Because we define equilibrium through the equality of profits in the two sectors, the technology parameters do not affect the distribution of firms, nor the wage. We'll see in the next section that these parameters become crucial when analyzing disequilibrium paths. Notice also that, as $(\xi_b + \xi_a) - 2\sqrt{\xi_b\xi_a} > 0$, the wage is always positive. On the other hand, equation 8a gives conditions on the parameter for the equilibrium to be meaningful

$$1 < \alpha^* = N\frac{\sqrt{\xi_a}}{\sqrt{\xi_b}+\sqrt{\xi_a}} < N.$$

The second inequality is certainly verified, while the first implies, with some manipulation,

$$\alpha^* > 1 \iff \frac{W_a}{W} > \frac{1-\gamma\delta(1+(N-1)^2)}{(1+(N-1)^2)(1-\gamma)}.$$

If external demand for the advanced sector is not large enough, the equilibrium number of firms may be lower than 1.

3.2 Reaction to Shocks

Using equations 8a and 8b, and the fact that $\frac{d\alpha}{dW_j} = \frac{\partial\alpha}{\partial\xi_b}\frac{\partial\xi_b}{\partial W_j} + \frac{\partial\alpha}{\partial\xi_a}\frac{\partial\xi_a}{\partial W_j}$, we can write

$$\begin{aligned}
\frac{d\alpha}{dW_b} &= \left(\frac{\sqrt{\xi_b}}{\sqrt{\xi_a}}\gamma\delta - \frac{\sqrt{\xi_a}}{\sqrt{\xi_b}}(1-\gamma\delta)\right)\left(\frac{N}{2\left(\sqrt{\xi_b}+\sqrt{\xi_a}\right)^2(1-\gamma)}\right) \\
\frac{d\alpha}{dW_a} &= \left(\frac{\sqrt{\xi_b}}{\sqrt{\xi_a}}(1-\gamma+\gamma\delta) - \frac{\sqrt{\xi_a}}{\sqrt{\xi_b}}(\gamma-\gamma\delta)\right)\left(\frac{N}{2\left(\sqrt{\xi_b}+\sqrt{\xi_a}\right)^2(1-\gamma)}\right)
\end{aligned}$$

We are now able to prove a number of propositions:

Proposition 1 $\frac{d\alpha}{dW_a} > 0$ *and* $\frac{d\alpha}{dW_b} < 0$. *An increase of external demand for a sector yields a larger equilibrium number of firms in that sector.*

Proof. $\frac{d\alpha}{dW_a} > 0$:

$$\left(\frac{\sqrt{\xi_b}}{\sqrt{\xi_a}}(1-\gamma+\gamma\delta) - \frac{\sqrt{\xi_a}}{\sqrt{\xi_b}}\gamma(1-\delta)\right) > 0$$

$$\iff$$

$$\xi_b(1-\gamma+\gamma\delta) - \xi_a\gamma(1-\delta) > 0$$

Substituting:

$$\begin{aligned}
&((1-\gamma\delta)W_b + \gamma(1-\delta)W_a)(1-\gamma+\gamma\delta) - \\
&-(\gamma-\gamma\delta)(\gamma\delta W_b + (1-\gamma(1-\delta))W_a) \\
=\ & W_b(1-\gamma) > 0
\end{aligned}$$

$\frac{d\alpha}{dW_b} < 0$:

$$\left(\frac{\sqrt{\xi_b}}{\sqrt{\xi_a}}\gamma\delta - \frac{\sqrt{\xi_a}}{\sqrt{\xi_b}}(1-\gamma\delta)\right) < 0$$
$$\Longleftrightarrow$$
$$(\xi_b\gamma\delta - \xi_a(1-\gamma\delta)) < 0$$

Substituting:

$$\begin{aligned} & ((1-\gamma\delta)W_b + \gamma(1-\delta)W_a)\gamma\delta - \\ & -(1-\gamma\delta)(\gamma\delta W_b + (1-\gamma(1-\delta))W_a) \\ = \; & (\gamma-1)W_a < 0 \end{aligned}$$

■

Proposition 2 $\frac{d\pi_a}{dW_a} > 0$ *and* $\frac{d\pi_a}{dW_b} > 0$. *An increase in external demand for any sector yields a larger equilibrium profit.*

Proof. Equilibrium profit can be defined, from eqs. 6 and 8a:

$$\pi_a(=\pi_b) = \frac{\xi_a}{\alpha^2} = \frac{\left(\sqrt{\xi_b}+\sqrt{\xi_a}\right)^2}{N^2}$$

As ξ_a and ξ_j are positively affected by both W_a and W_b, we conclude that any increase in external demand increases equilibrium profits ■

The reaction of wages to external demand shocks is harder to sign, because in fact it depends on the size of the reallocation of workers between the two sectors.

$$\begin{aligned} \frac{\partial w}{\partial W_a} &= \frac{\sqrt{\xi_b\xi_a}(N-1) - (\gamma(1-\delta)\xi_a + (1-\gamma+\gamma\delta)\xi_b)}{LN\sqrt{\xi_b\xi_a}(1-\gamma)} \\ \frac{\partial w}{\partial W_b} &= \frac{\sqrt{\xi_b\xi_a}(N-1) - ((1-\gamma\delta)\xi_a + \gamma\delta\xi_b)}{LN\sqrt{\xi_b\xi_a}(1-\gamma)} \end{aligned}$$

Once studied the steady state properties of our model, we can introduce the dynamic elements that essentially involve capacity building and expectations, in the spirit of Amendola and Gaffard (1998). The model will extend to a two sector Cournot economy the paper by Saraceno (2004).

4 Adding a Time Structure

Section 2 argued that trade shocks are analytically equivalent to productivity shocks in that they trigger a structural change with the associated distortions that have to be managed for the transition to be successful. To model structural change in a production economy, four ingredients are required: *First*, Production takes time, and is often characterized by complementarity rather than substitutability in the factors. This is captured analytically by assuming a Leontief production function that uses labour inputted at different times. *Second*, agents have bounded rationality, especially when facing complex environments. Thus, expectations are adaptive. *Third*, no variable may move instantaneously. As in temporary equilibrium models (Hicks, 1939; Benassy, 1982), prices only adjust between periods; *ex-ante* disequilibria within the period are eliminated by rationing and stock accumulation. *Fourth*, agents are constrained, in their transactions, by financial availability. This sort of credit or cash-in-advance constraint emerges because markets open sequentially.

4.1 The Sequence

Each period begins with some state variables inherited from the previous one. First, labour embedded in production processes (as will be clear below); then, stocks that result from past disequilibria. And finally, the prices and wages.

Within the period we introduce a sequence that helps in defining the time structure of the model.

- Prices and wages change in response to market disequilibria, even if we do not let them clear markets.
- Firms may also change sector, based on realized profits in the previous period.
- Then, after agents form inter and intra period expectations, and accordingly desired demands and supplies. In particular firms form a demand for labour, and a demand for financial means (the wage fund)
- The first market that opens is the financial market, in which demand for external funds may or may not be satisfied. Financial constraints cause a rescaling of labour demand.
- Total labour employed is determined once the second market, the labour market opens. Then wages are paid, and production is carried over.

Households adjust their desired demands based on the actual wage perceived.

- Finally, the product market opens, and as in the other markets, the short side rule applies.

The next sections will detail this sequence.

4.2 Wage Dynamics

Wages change early in the period, following previous disequilibria:

$$w_t = w_{t-1}\left[1 + \omega\frac{L^d_{t-1} - L^s_{t-1}}{L^s_{t-1}}\right]$$

Thus ω is an indicator of price flexibility; as the equation clarifies, this has nothing to do with market clearing behaviour.

4.3 Firm Dynamics

Firms may change sector of activity. This happens when profits differ:

$$\alpha_t = \alpha_{t-1}\left[1 + \theta\frac{\pi_{a,t-1} - \pi_{b,t-1}}{\pi_{a,t-1} + \pi_{b,t-1}}I_a\right]$$

where I_a is an indicator function taking a value of 1 only if $n \in (1, N)$. Firms changing sector still use the built productive capacity to carry on production in the original sector, but invest in the other sector.

4.4 Expectations

Previous work (Amendola and Gaffard, 1998; Saraceno, 2004) has explored the role of expectations in this type of models. We could show rather robustly that when interacting with sunk costs and irreversibilities in the production process, adaptive expectations play an important role. We also argued at length that in a complex environment, when collecting complete information may be impossible or extremely costly, agents may find it more convenient to follow an adaptive rule. Long term expectations, that drive investment decisions, are instead more independent of contingent conditions.

Coherently with these arguments, in this paper we make different assumptions regarding assumptions: short term or *intraperiod* expectations are backward looking. Firms decide how much they wish to produce in the

current period, based on their expectation of current demand, that in turn is determined by the expected level of employment. The latter is determined as an average between past employment and its "normal" value

$$L_t^e = \phi L_{t-1} + (1-\phi)L^*$$

where $L^* = L$ is the steady state level of employment.

If we are not at full employment, we have to write expected revenues as the sum of paid wages, plus distributed profits

$$R_t^e = w_t L_t^e + \Pi_{t-1} + H_{t-1}^h$$

where $\Pi = \Pi_a + \Pi_b$. Notice that we add an additional term (H^h): if households had been left with unspent money balances in the previous period, these balances will concur to form current revenues. Expected demand then becomes

$$\begin{aligned} x_{a,t}^e &= \frac{\alpha_{t-1}-1}{\alpha_{t-1}^2 A_a w_t}\left(\gamma\delta R_t^e + W_{a,t}\right) \\ x_{b,t}^e &= \frac{\beta_{t-1}-1}{\beta_{t-1}^2 A_b w_t}\left(\gamma(1-\delta) R_t^e + W_{b,t}\right) \end{aligned}$$

It is important to remark that agents take into account the fact that firms having switched sector do not possess productive capacity (otherwise, α_t and β_t would have been used instead of α_{t-1} and β_{t-1}); we assume in other words that agents use all the information they possess, in order to be as close as possibly allowed, in this context, to rational expectations. The amount firms will actually attempt to produce, depends also on stocks of goods left from disequilibria from past periods, that the firm is able to bring back on the market.

$$s_{j,t}^e = x_{j,t}^e - o_{j,t-1}$$

Finally, *interperiod* expectations, are important to determine how much to invest, i.e. how many workers to hire today to put in place tomorrow's production. We assume that these decisions are not influenced by short term movements:

$$L_{t+1}^e = L^* = L$$

4.5 Production and Labour Demand

The two elements of complementarity and time-to-build are introduced by assuming that the production function takes the form of a Leontief function with dated labour input

$$s_{j,t} = \min[\kappa_j l_{j,t-1}, \lambda_j l_{j,t}]$$

where $j = a, b$ denotes the sector. Thus, dated and current labour concur in fixed proportions to the determination of production; this formulation is equivalent at assuming production to be undertaken with capital built in the previous period, that fully depreciates. Thus, current production is constrained among other things by past "investment". If firms don't possess the appropriate amount of capital/dated labour, they will not be able to produce as much as they wish. As a consequence, firms will only demand the labour they really need:

$$l_{j,t} = \frac{1}{\lambda_j} \min \left(s^e_{j,t}, \kappa_j l_{j,t-1} \right).$$

Labour demand is hence given by

$$\begin{aligned} L^d_t &= L^d_{a,t} + L^d_{b,t} \\ &= \left(\frac{s^e_{a,t+1}}{\kappa_a} + l_{a,t} \right) \alpha_t + \left(\frac{s^e_{b,t+1}}{\kappa_b} + l_{b,t} \right) \beta_t \end{aligned}$$

4.6 The Financial Sector: Demand and Supply for External Funds

Demand for external funds comes from whatever of the wage bill is not covered by past profits. Money demand may then be written as the difference between the wage fund and internal resources.

$$F^d_{t,j} = w_t L^d_{t,j} - (S_{t-1,j} + H^f_{t-1,j} - \Pi_{t-1,j}) \tag{9}$$

where S is the value of past sales in the two sectors, and H^f denotes involuntary monetary hoardings by firms. Equation 9 embeds the credit constraint: the firm system needs additional funds for whatever of the wage pool it cannot finance out of internal resources. As profits are distributed to households at the end of the period, they are not available for firms.

The behavior of the supply side in the financial market is not explicitly modeled. In fact, we adopt a very stylized representation, in which the supply of external funds can be interpreted as credit made available by the financial sector. We simply assume that the supply of credit by financial sector is adversely affected by turbulent times (proxied in our model by the variability of profits), and by the strength of the economy, proxied by the unemployment rate):

$$F^s_{t,j} = \max \left(0, F^d_{t,j} - (1 - \mu)(Var[\pi_j] + \psi u_{t-1}) \right)$$

where $\mu \in [0,1]$, and $Var[\pi_j]$ is the past variance of π_j. In words, we assume that the financial sector will react to increasing variability of profits, or to deteriorating macroeconomic conditions, by tightening the flow of credit. Larger values of the parameter μ will capture a more accommodating credit market, while credit constraints will be more important at low levels of μ. At the steady state, with no unemployment and constant profits, money demand F_j^d will be accommodated.

The credit market is the first to open. This modeling trick allows to implicitly introduce a financial constraint. If firms are unable to access to the needed external funds, then they won't be able to carry on their planned investment. The parameter μ, that we leave exogenous, is the crucial variable to help understand the effect of credit rationing on the path followed by the economy.

4.7 The Labour Market

If $F_t^s < F_t^d$, then firms will not be able to hire as many workers as they desire. Total labour demand is then equal to

$$\hat{L}_t^d = \frac{F_t^s + (S_{t-1} + H_{t-1}^f - \Pi_{t-1})}{w_t}$$

(hats denote constrained quantities). In the simulations below we will assume that firms first reduce investment, i.e. labour demand for the construction phase. If funds are still not enough, then current production has to be curtailed as well.

The second market to open is the labour market. If $L > \hat{L}_t^d$ we have unemployment, otherwise a human resource constraint will occur. Effective employment will thus be determined by the short side of the market

$$L > \hat{L}_t^d \Rightarrow L_t = \hat{L}_t^d$$

$$L < \hat{L}_t^d \Rightarrow L_t = L$$

Rationing will affect all firms in the two sectors proportionally, i.e. $\hat{L}_{j,t} = L_{j,t}^d \frac{L}{\hat{L}_t^d}$.[1]

[1]Notice that an issue of strategic behaviour could arise here: knowing the rationing rule, firms could modify their behaviour in order to obtain, once rationed, their optimal quantity. We overlook this issue, as it presupposes perfect knowledge by the firm of the behaviour of its competitors in their own as well as in the other sector.

4.8 Production and the Goods Market

Once the labour market is closed, wages are paid, and production is carried on. The last market to open is the goods market. Supply depends on what happened previously in the sequence:

$$\begin{aligned} x^s_{j,t} &= \min[\kappa_j l_{j,t-1}, \lambda_j l_{j,t}] + o_{j,t-1} \\ p_{a,t} &= w_t \frac{\alpha}{\alpha - 1} A_a \qquad p_{b,t} = w_t \frac{\beta}{\beta - 1} A_b \end{aligned}$$

Notice that $l_{j,t}$ embeds all the constraints that may have arisen along the sequence. On the demand side, actual employment determines the resources, and total demand

$$\begin{aligned} R_t &= L_t w_t + \Pi_{t-1} + H^h_{t-1} \\ X^d_{a,t} &= \gamma\delta R_t + W_{a,t} \\ X^d_{b,t} &= \gamma(1-\delta) R_t + W_{b,t} \end{aligned}$$

The short side rule applies to the goods market as well, so that we have

$$X^d_{j,t} > X^s_{j,t} \Rightarrow H^h_{j,t} = p_{j,t}\left(X^d_{j,t} - X^s_{j,t}\right)$$

$$X^s_{j,t} > X^d_{j,t} \Rightarrow O_{j,t} = X^s_{j,t} - X^d_{j,t}$$

The equation for H^h implicitly assumes that external demand W_j is satisfied in priority. The period ends at this point. The state variables that link it to the other periods are the stocks H and O, the wage level w, and the capacity (the quantity of labour stocked to carry on production in the following period.

The next section will investigate, by means of simulations, how the transition for an economy takes place after a shock. In particular, we will focus on the role of credit in facilitating the transition between different equilibria.

5 Out-of-equilibrium Paths

The technology parameter values we chose show a basic sector in which very few workers are needed in the construction phase, while a substantial amount of labour concurs to the production phase. On the contrary, the advanced sector is capital intensive, in the sense that most of the labour has to be applied in the construction phase. We further chose the technology parameters in such a way that overall steady state productivity (X_j/L_j, $j = a, b$) is larger

in the advanced sector[2]. We investigated the path followed by the economy following a negative shock at time $t = 10$ in the basic sector (specifically, $W_{b,10} = 0.8W_{b,9}$). The new steady state will then be characterized by lower wages and profits, and an increase of the number of firms in the advanced sector.

We consider the three institutional variables that affect the transition towards the new equilibrium, notably the degree of wage stickiness ω, the speed of firm migration from less profitable to more profitable sectors θ, and the degree of accommodation of the financial sector, μ.

We first began with a low rate of firm migration ($\theta = 0.05$), and we simulated three series of scenarios that correspond to different and alternative degree of reaction of wages to labour market disequilibria: fixed ($\omega = 0$), sticky ($\omega = 0.05$) and flexible wages ($\omega = 0.5$). With fixed wages (figures 1 and 2) the economy will converge towards a sort of Keynesian equilibrium characterized by a constant rate of unemployment. Because wages do not fall, unemployment is not reabsorbed. This has an effect on aggregate demand, and supply in both sectors decreases. What is interesting is that whether the financial sector accommodates investment or not does not make a difference, as we can observe by comparing figure 1 with figure 2.

If we introduce a moderate reactivity of wages ($\omega = 0.05$, figures 3 and 4), the system converges towards equilibrium. After the initial drop in profits and production, due to the negative shock on employment, the decrease in wages allows unemployment to be reabsorbed, while aggregate demand increases again. This gives the firms the resources they need to carry on production and investment, and to converge to the new steady state. Not surprisingly then, even in this case there are no major differences related to the intensity of the credit constraint. In fact, the transition is financed out of internal funds.

The existence of a credit constraint becomes crucial when wages are very sensitive to labour market disequilibria. Figures 5 and 6 show the dynamics corresponding to $\omega = 0.5$. In this case, and with a tight credit constraint, the sharp reduction in wages following the initial unemployment affects aggregate demand. Even as unemployment initially drops, the wage fund is reduced, and firms face decreasing demand and profits. As a consequence investment will be constrained, and the resulting evolution of the system is not viable (figure 5). If financial markets accommodate the investment needs of firms, as in figure 6, then the lack of internal resources can be compensated by external money, and the economy converges towards a new steady state with

[2]Specifically, we have $\kappa_b = 1.6$, $\kappa_a = 0.8$, $\lambda_b = 0.2$, $\lambda_a = 10$. Overall productivity in the two sectors is then $X_b/L_b = 0.17$ and $X_a/L_a = 0.74$

full employment.

If firms change sector more easily (i.e., with $\theta = 0.1$), the tendency of the system to instability naturally increases. In fact, as firm migration means investment effort without a corresponding output (productive capacity has to be built beforehand), if too many firms migrate at the same time, the disruption in productive capacity will feed back in lower employment, demand and again in production, in a vicious circle. Then, when wages are fixed (see figure 7 where $\mu = 0$. The equivalent with $\mu = 1$ is similar and available upon request) the fall in aggregate demand will be limited, and the system will be able to recover coordination (albeit in a pseudo equilibrium with persistent unemployment)[3]. But as soon as we introduce wage variability, even moderate (figure 8), the migration of firms will disrupt the productive capacity of the economy, and the fall of wages will affect aggregate demand, revenues and the financing capacities of firms. As a consequence, only an accommodating financial sector will allow investment to be financed, and the new equilibrium to be reached (figure 9).

This set of results shows that the natural tendency of the system to converge to the new equilibrium may be hampered by excessive variations in wages and or by too fast migration between sectors; these may trigger, via aggregate demand effects, an important drop in the investment capacity of firms; In turn, if this lack of resources is not compensated by the financial sector, the insufficient investment disrupts the productive capacity of the economy, and triggers a cumulative explosive process. Therefore, re-establishing the coordination between investment and consumption and reabsorbing unemployment requires an accommodating credit policy.

We also simulated the case of a positive shock on the demand for basic goods, a shock that typically hits developing countries. In this case, the responsiveness of wages to labour market disequilibria does not seem to play a major role whereas the viability of the transition will systematically require easy access to credit. Figures 10 and 11 prove this point for rigid wages ($\omega = 0$. The other figures are available upon request).

5.1 Robustness

The time series results reported above need to be generalized to make sure that the results do not depend on the particular set of parameters used for the

[3]This simulation extends to a disequilibrium framework Keynes' argument for wage rigidity as a means to avoid cumulative aggregate demand - aggregate supply downward spiraling (see the chapter on wages of Keynes, 1936). For a detailed discussion of this argument refer to Amendola, Gaffard and Saraceno (2004) and Saraceno (2004)

simulations. To this end we thoroughly investigated the relevant parameter space to assess whether our results are robust or not.

We randomly drew (500 times) the three parameters $\theta \in [0, 0.2]$ $\omega \in [0, 0.5]$ and $\mu \in [0, 1]$ to lie between the extreme values of the simulations above; for each of these draws we ran the dynamic system for 100 periods, always perturbing it with a negative external demand shock ($\Delta W_b = -0.2$). We then recorded, along with the parameter values, the final level of unemployment and other variables of interest (variance of profits along the run, etc). The result of this Monte Carlo experiment strongly confirms the conclusions we drew from the analysis of time series. Figure 12 shows a plot of unemployment for the complete sample (500 draws). It shows that many runs are not viable, as they are clustered at a near 100% level. The linear trend lines show that the non viable processes are more frequent for high levels of ω and θ, thus confirming that excessive flexibility has a destabilizing effect on the transition process. (we also reported 'total flexibility', proxied by the sum $\theta+\omega$). As for the effects of financial constraints, the Monte Carlo experiment shows that higher levels of μ -a more accommodating financial sector- are associated with lower unemployment, thus also confirming the findings of out time series analysis.

We made this impressionist statement more rigorous by building a binary regression model on the dataset created by the experiment, i.e. associating a 1 to each viable process (defined as a process that has a long run unemployment rate of less than 30%) and a 0 otherwise. According to this definition, around 25% of the processes (127 out of 500) were viable. The results of the probit regression are reported in table 1, that once again confirms our findings. While it is well known that the coefficients do not represent the marginal effect of the regressors, their sign gives the direction of change. Thus, a positive coefficient for μ means that more accommodating financial markets make the viability of processes more probable, while the negative coefficients of ω and θ imply that excessive flexibility in the labour market or in the migration of firms reduce the probability. By looking at figure 13 we can finally notice that the pattern is clearer for ω than for θ: the distribution of wage flexibility parameters for viable processes is clearly skewed, while for firm migration the pattern is less clear.

While the negative role of flexibility in what concerns the viability of transition emerges robustly from our analysis, excessive rigidity may also be a problem. Figure 14 shows the same plots as figure 12, for the subsample of 127 viable processes. As can be seen, to larger ω now correspond lower unemployment, while θ is still positively associated with unemployment. The latter effect being smaller, increasing total flexibility *within the subset of viable processes*, reduces unemployment. The subset of viable processes also

Dependant Variable: $Viable = 1$

Variable	$Coeff.$ $(stderr)$	p-value
$Const$	0.448 (0.24)	0.0624
μ	1.46 (0.26)	0.000
ω	−6.56 (0.70)	0.000
θ	−5.70 (1.24)	0.000
pseudo $R^2 = 0.34$		
nobs.: 500 $(dep = 1 : 127)$		

Table 1: Probit regression. Dep. var. is 1 if long run unemployment rate is lower than 30%, 0 otherwise. Robust standard errors in parentheses. p-values are also reported.

higlights an interesting property of financial constraints, that show a binary behaviour: either they guarantee viability (in combination with other parameters), or they don't. And once viability is assured, there is no effect of μ on the performance of the economy. A regression analysis on unemployment within the subset of viable processes confirms our findings. Table 2 shows that μ is not significant in explaining unemployment, and that ω and θ interact in a nonlinear way. If we plot the coefficients for ω and θ of table 2, assuming in each case that the other variable takes its median value, we obtain figure 15. The figure shows that for very low values of ω unemployment is large, while for values larger than around 0.1 it fluctuates around zero. On the contrary, increasing the speed of migration of firms has a negative effect on unemployment even within the sample of viable processes.

To sum up, the disequilibrium transitions that we analyzed may apply to both advanced and emerging economies; the former are hit by increasing imports of basic goods, and the latter take advantage of low production costs and export increasing quantities of basic goods. Our simulations show that appropriate behaviours and policies should keep access to credit easy, in order to sustain the investment capacity of firms and to help to prevent excessive disturbances in the structure of productive capacity that hamper the growth process. We further show that excessive flexibility in wage adjustment and in the speed of migration between sectors have a negative effect on viability. Nevertheless, once the particular combination of these three factors guarantees the overall success of disequilibrium transitions, we observe that

Dependant Variable: *unemp*

Variable	Coeff.	Variable	Coeff.	Variable	Coeff.
C	3.57 (3.07)	θ	142.9 (2.65)	$\omega\theta$	−571.9 (−2.86)
ω	−173.2 (−10.2)	θ^2	−1515.29 (−2.68)	$(\omega\theta)^3$	−330211 (−3.00)
ω^2	1968.1 (6.96)	θ^4	48855 (2.61)	$(\omega\theta)^6$	$-7.98E08$ (−2.66)
ω^3	−6739.9 (−5.75)	θ^7	−4768016 (−2.32)	$\omega^2\theta^3$	251560 (3.07)
ω^5	33305 (4.85)	μ	−1.62 (−0.87)		
ω^6	−38087 (−4.62)	μ^2	1.536 (0.825)		
$R^2 = 0.678$	Nobs.: 127				

Table 2: Regression results. Dependent variable is final unemployment. T-stats in parentheses.

excessive wage rigidity prevents the adjustment and hence delivers excessive unemployment, and that financial constraints do not play a major role in explaining unemployment. We concluded that the role of financial constraints is binary (on/off): either they make the process viable, or they don't. But once the process is viable, the performance of the economy is independent from availability of financial means.

6 Concluding Remarks

Changes in the geographical distribution of economic activities, which are in the nature of the growth process, may go hand-to-hand with internal distortions that emerge from an inevitable and powerful structural change and cannot be eliminated by simply liberalizing trade and allowing the economy to be as near as possible to a state of perfect competition. While public policies that would only focus on costs conditions and hence on competitiveness of territories could amplify these distortions, which are mistakenly attributed to international trade, gradual adjustments in an environment characterized by incomplete information and irreversibility (here defined as the existence of a time to build) should allow the hurt country re-establishing full employment and capturing productivity gains associated with specialization.

The different paths generated by the model, corresponding to different value of key parameters, confirm that the main issue lies not in the dramatic

changes in the imports and exports flows, that simply reveal changes in comparative advantages; rather, the problem lies in the way that internal (and unavoidable) distortions are dealt with. Loose monetary and exchange rate policies appear as the means required for reducing these distortions. But, the architecture of the financial system must also be considered insofar it is essential for determining transmission mechanisms. As a matter of fact, credit availability depends on the banks' (and shareholders') behaviour, which will be different according to the sectors' configuration, and which is affected by monetary policy in a complex way. Our purpose, here, is not to explore these transmission mechanisms, but simply to underline their extreme importance for the evolution of economies that may suffer or take advantage of markets' openness at the world level.

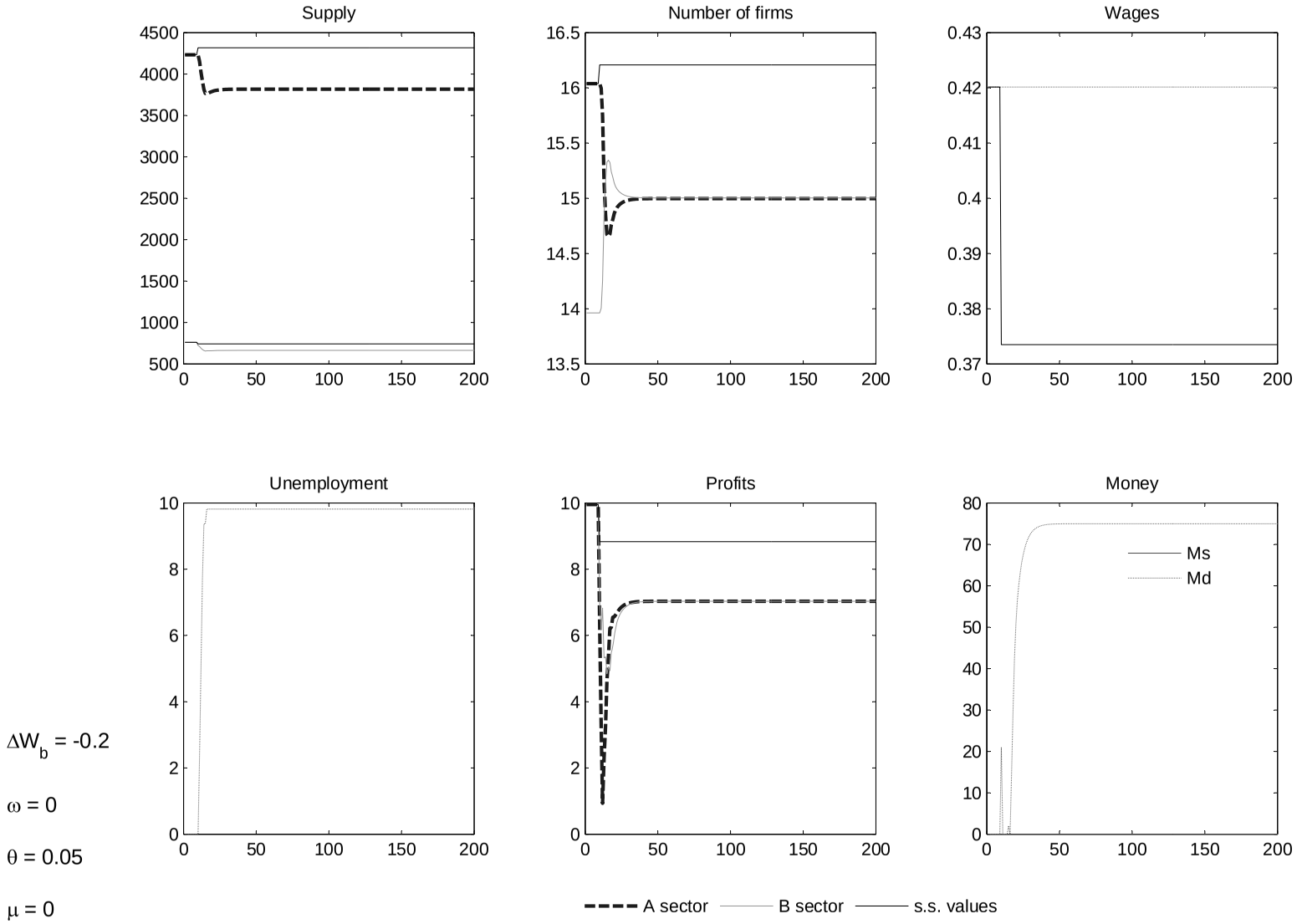

Figure 1: Negative shock to the basic sector. Fixed wages, low firm migration rates, binding credit constraints

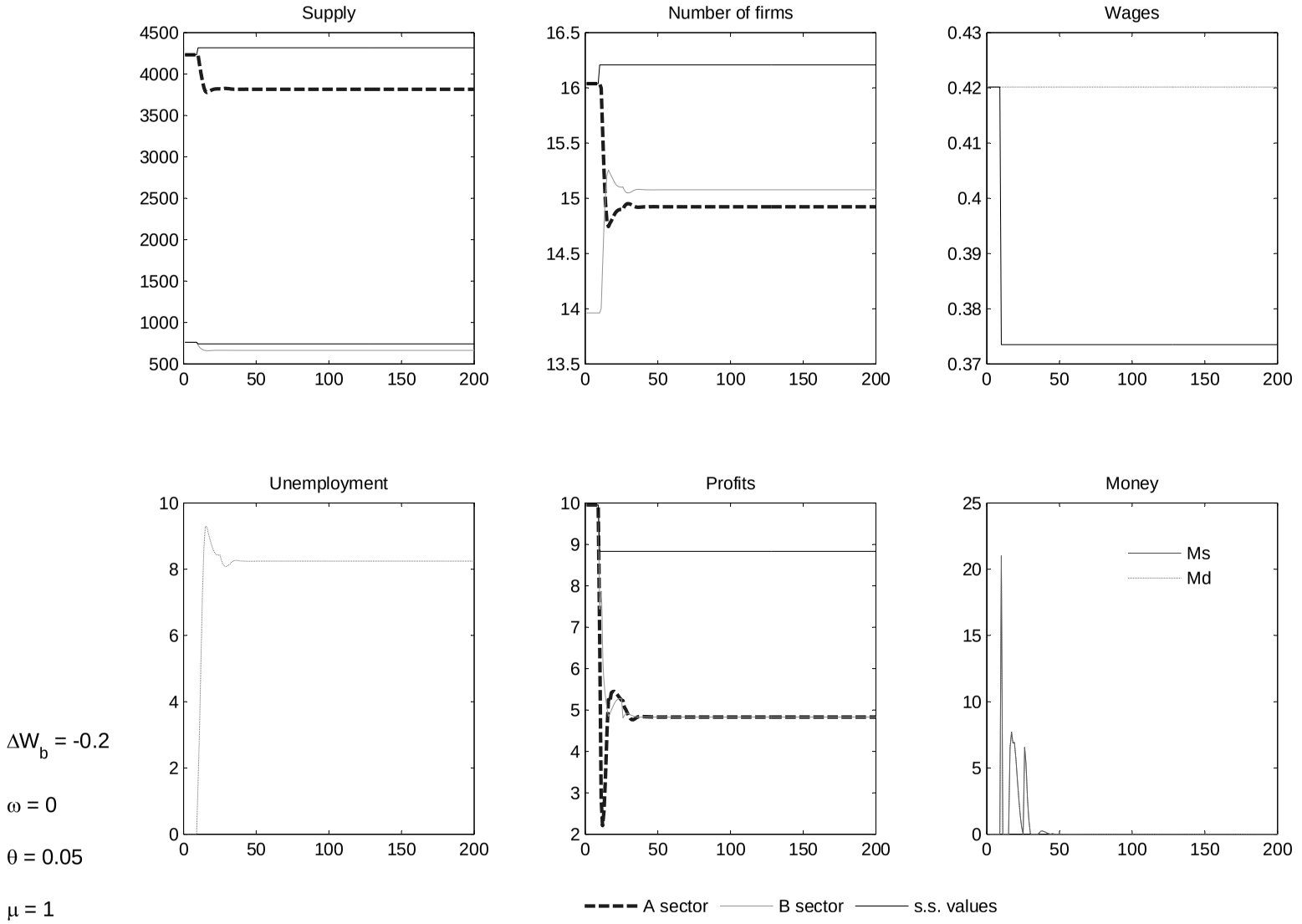

Figure 2: Negative shock to the basic sector. Fixed wages, low firm migration rates, Non binding credit constraints

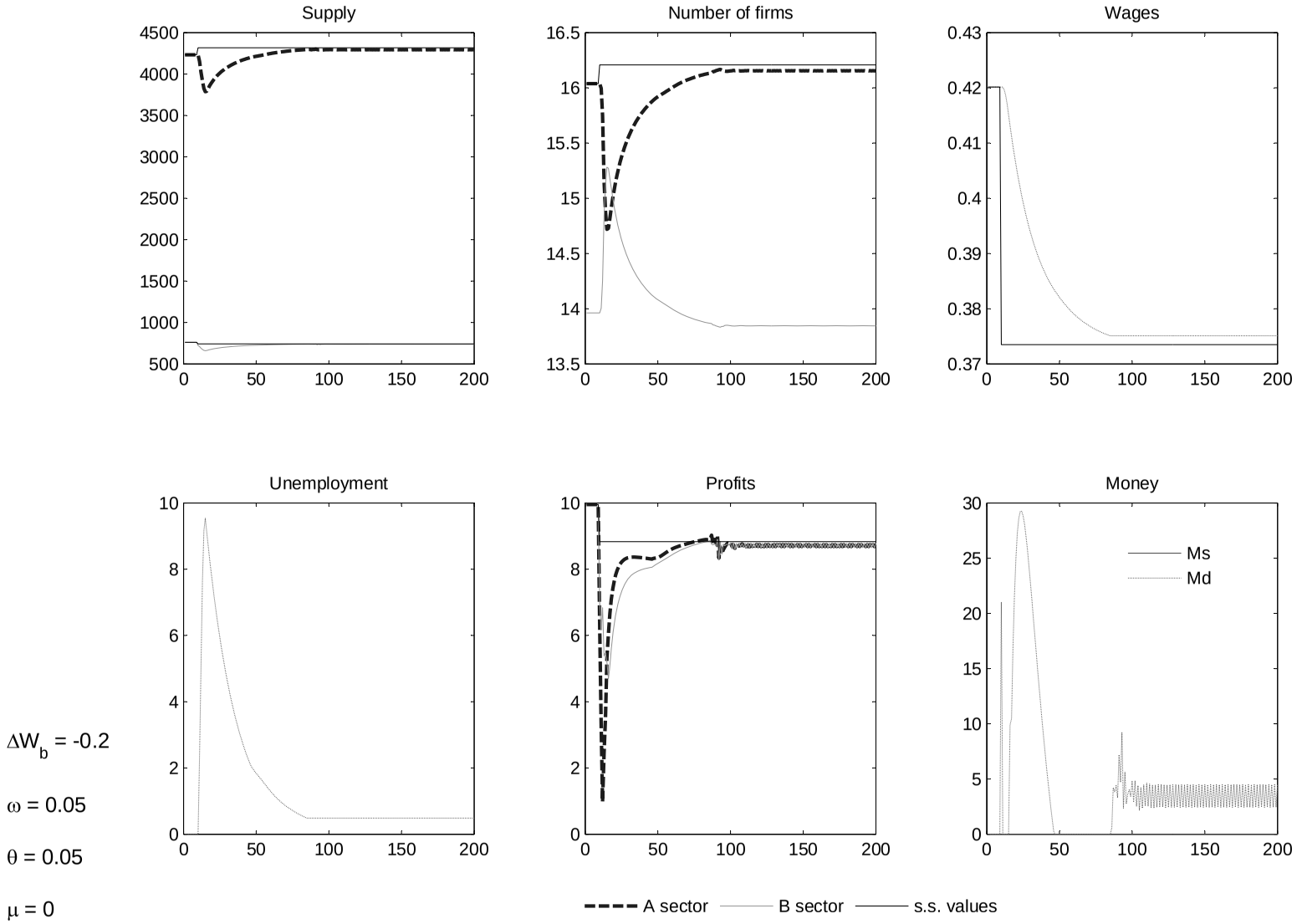

Figure 3: Negative shock to the basic sector. Sticky wages, low firm migration rates, binding credit constraints

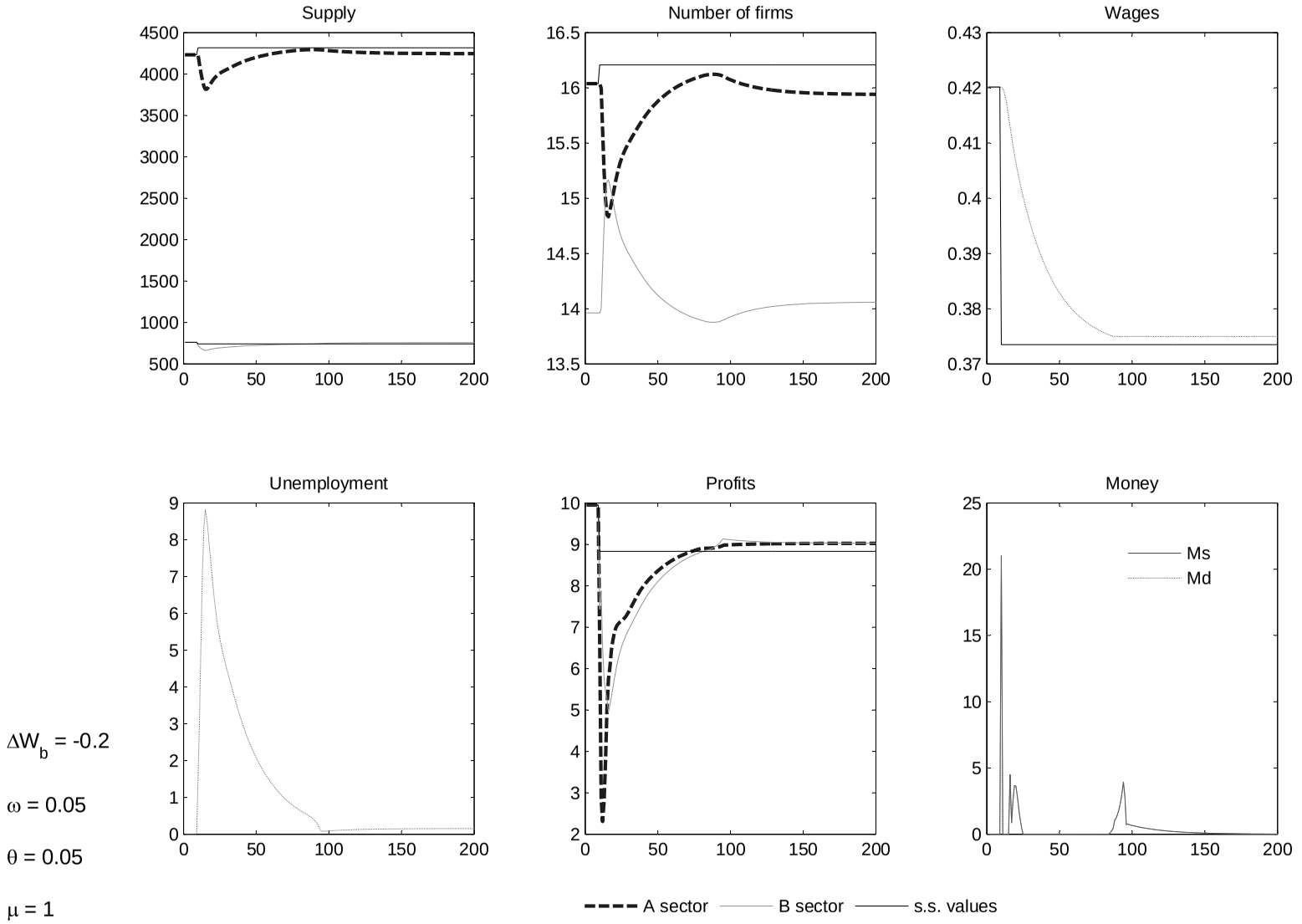

Figure 4: Negative shock to the basic sector. Sticky wages, low firm migration rates, Non binding credit constraints

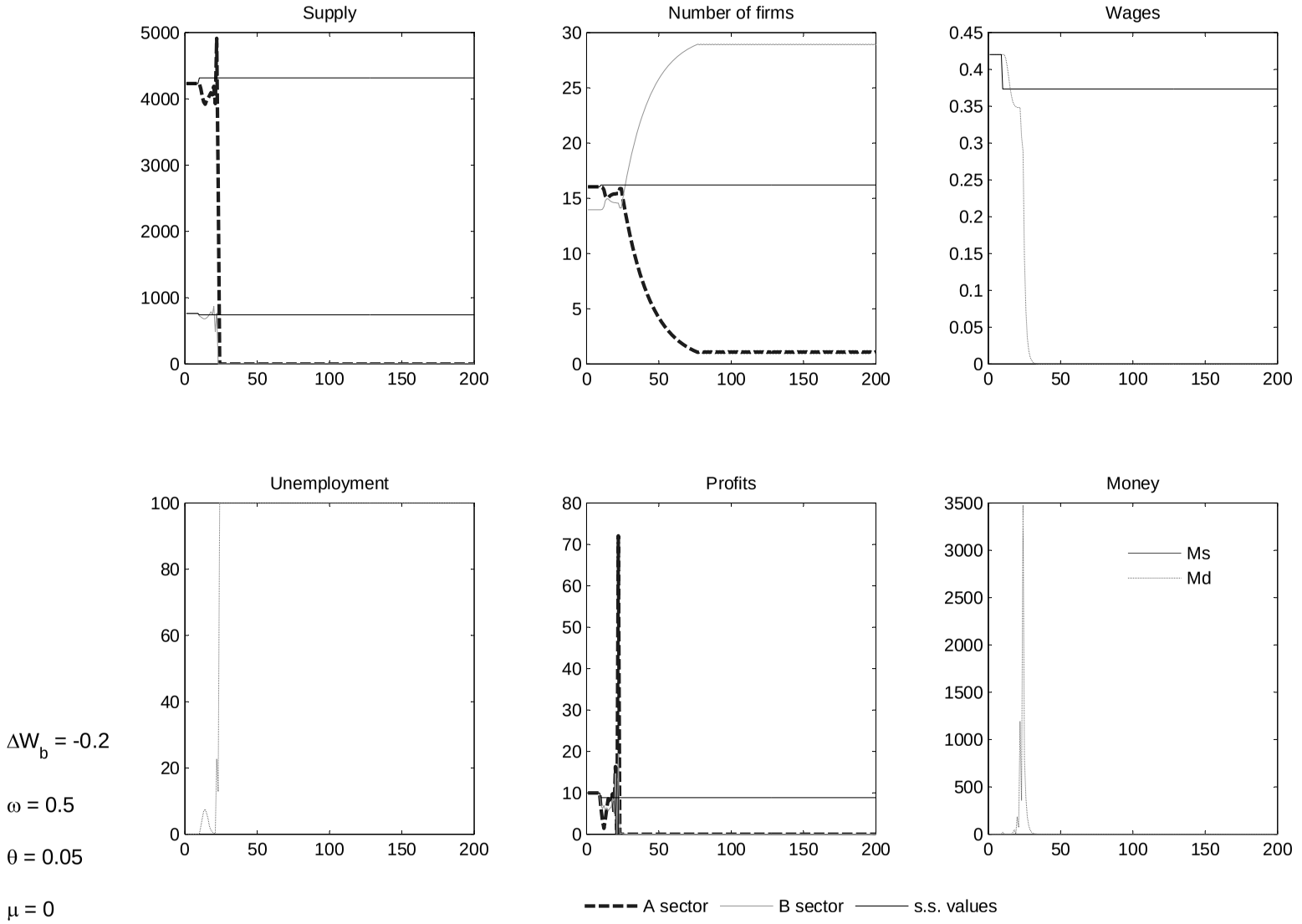

Figure 5: Negative shock to the basic sector. Flexible wages, low firm migration rates, binding credit constraints

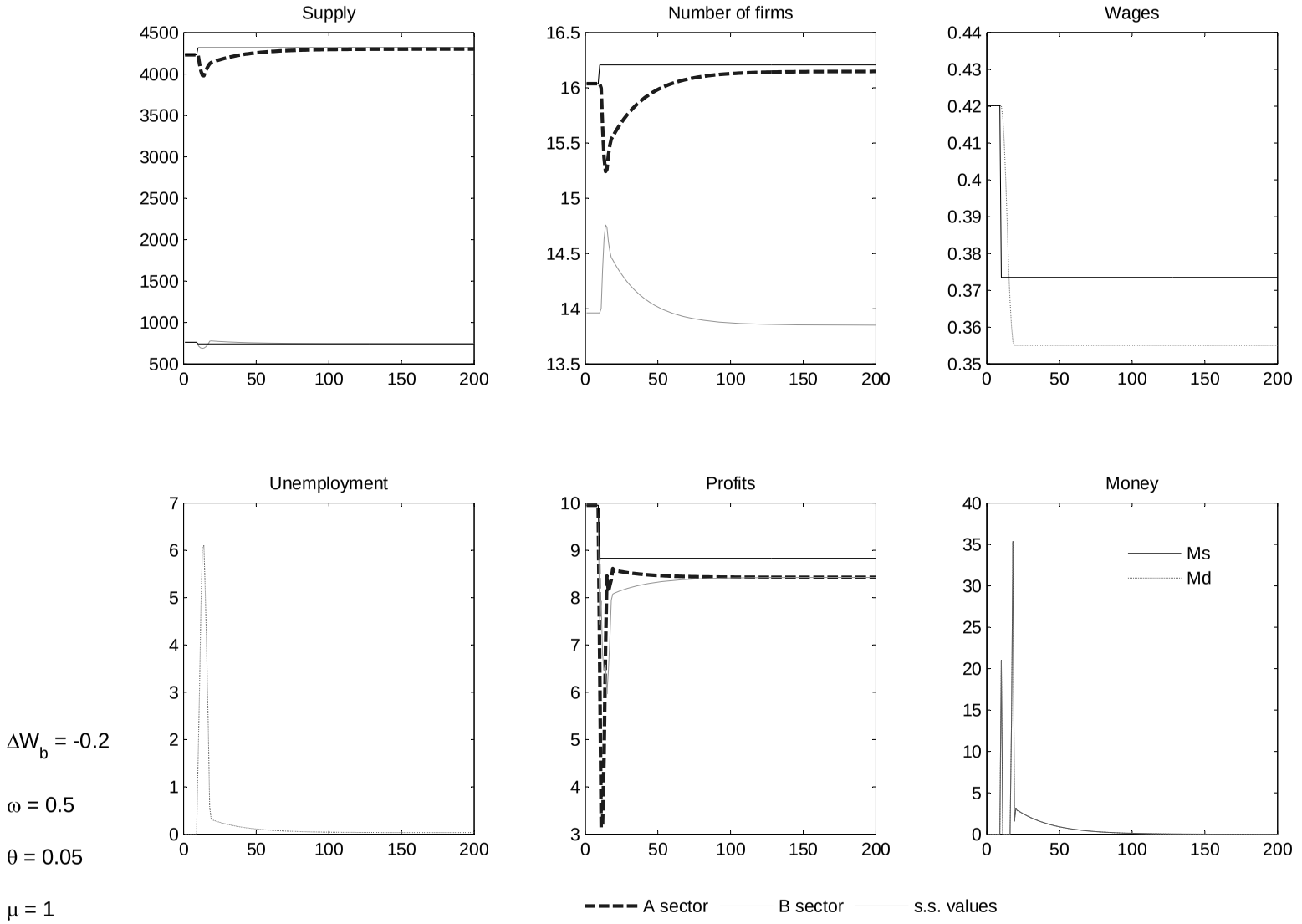

Figure 6: Negative shock to the basic sector. Flexible wages, low firm migration rates, Non binding credit constraints

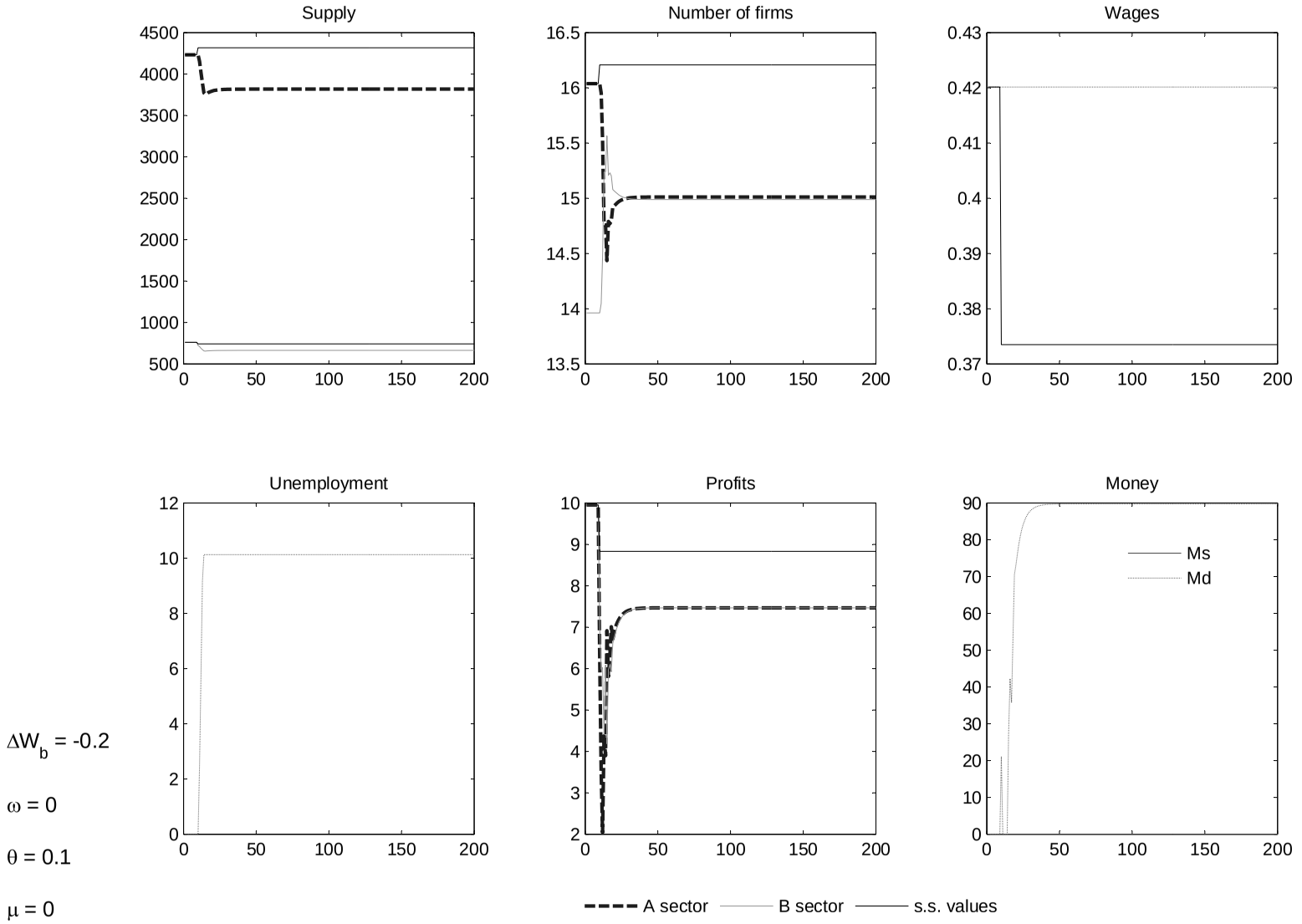

Figure 7: Negative shock to the basic sector. Fixed wages, High firm migration rates, binding credit constraints

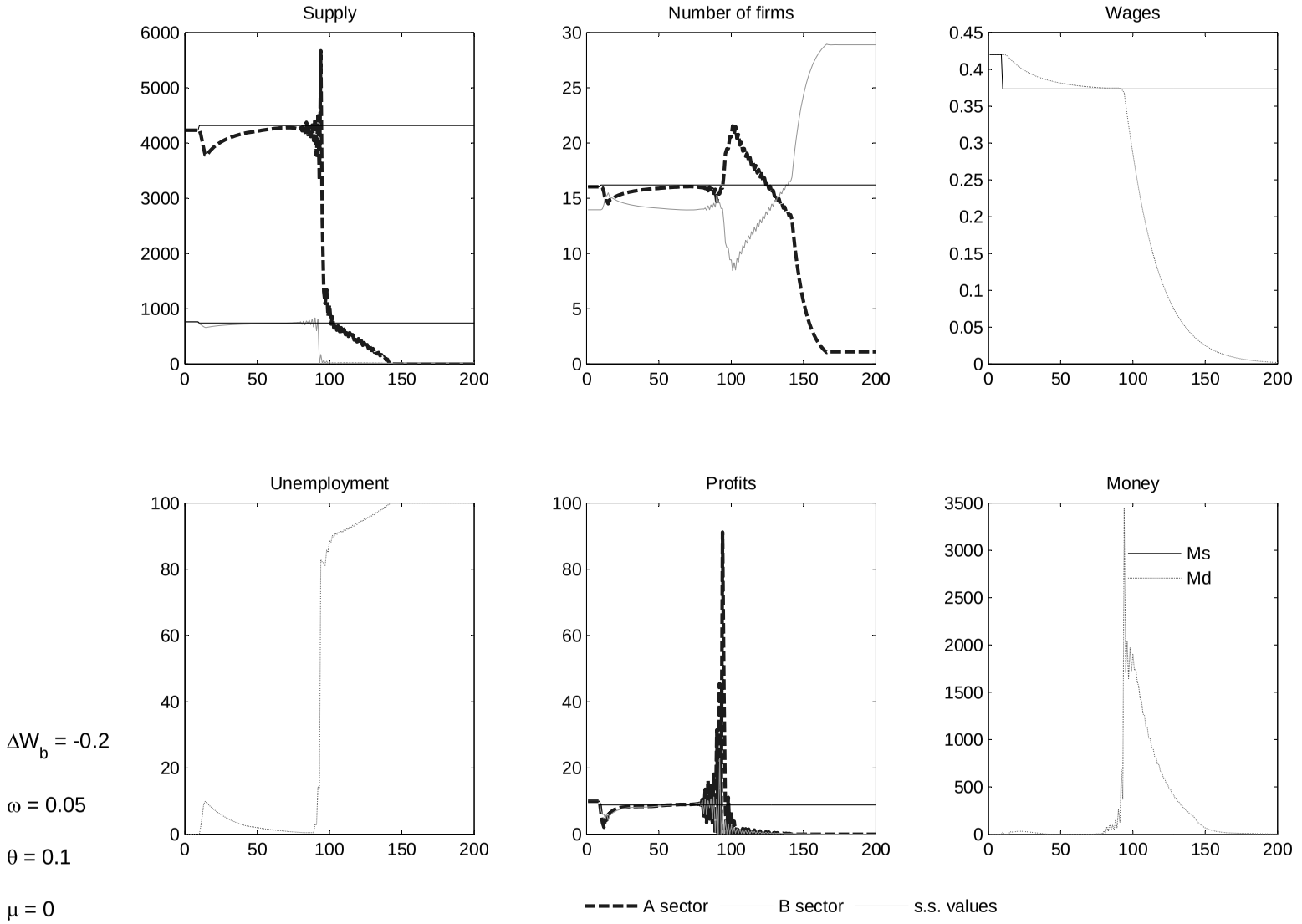

Figure 8: Negative shock to the basic sector. Sticky wages, high firm migration rates, binding credit constraints

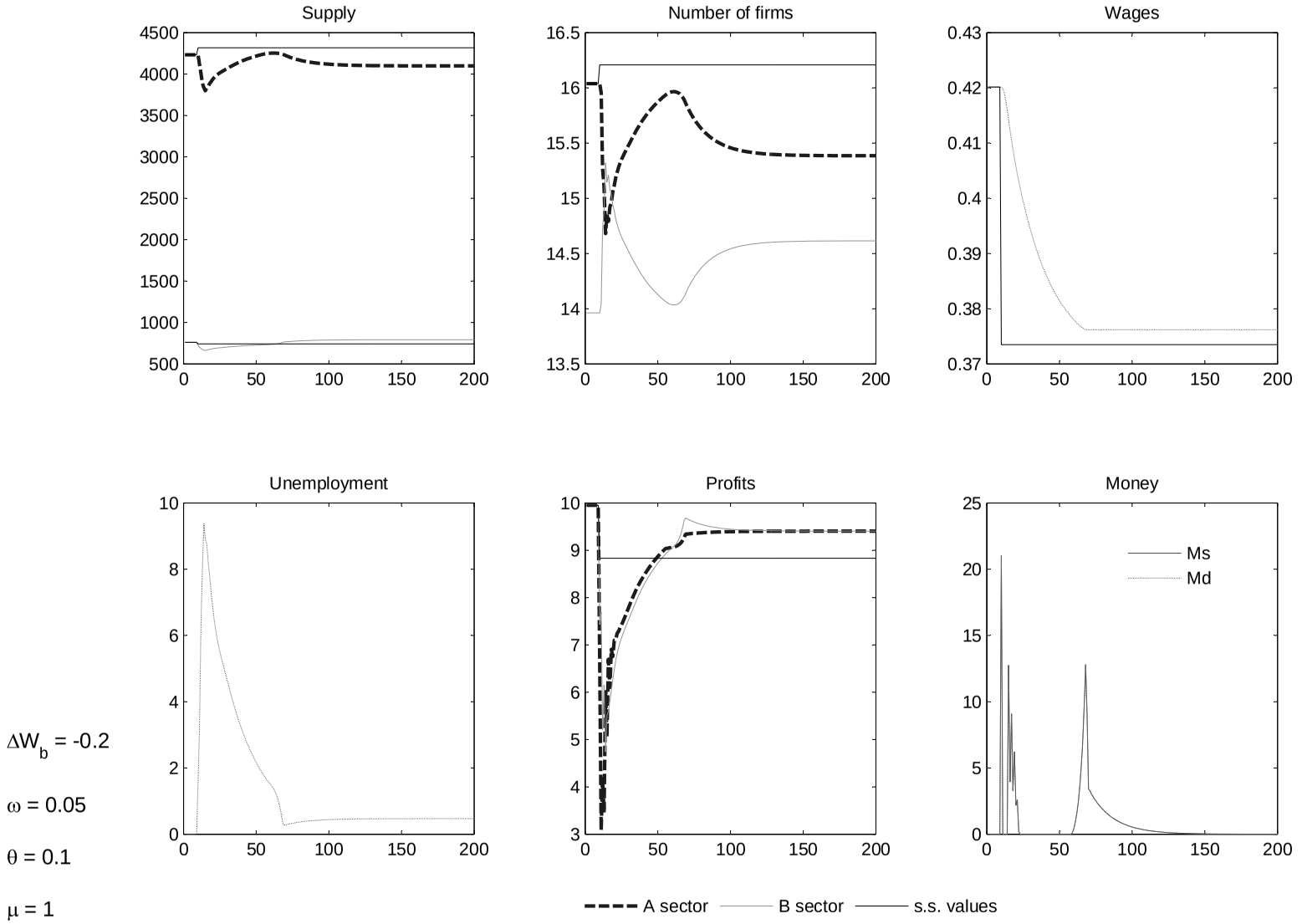

Figure 9: Negative shock to the basic sector. Sticky wages, high firm migration rates, Non binding credit constraints

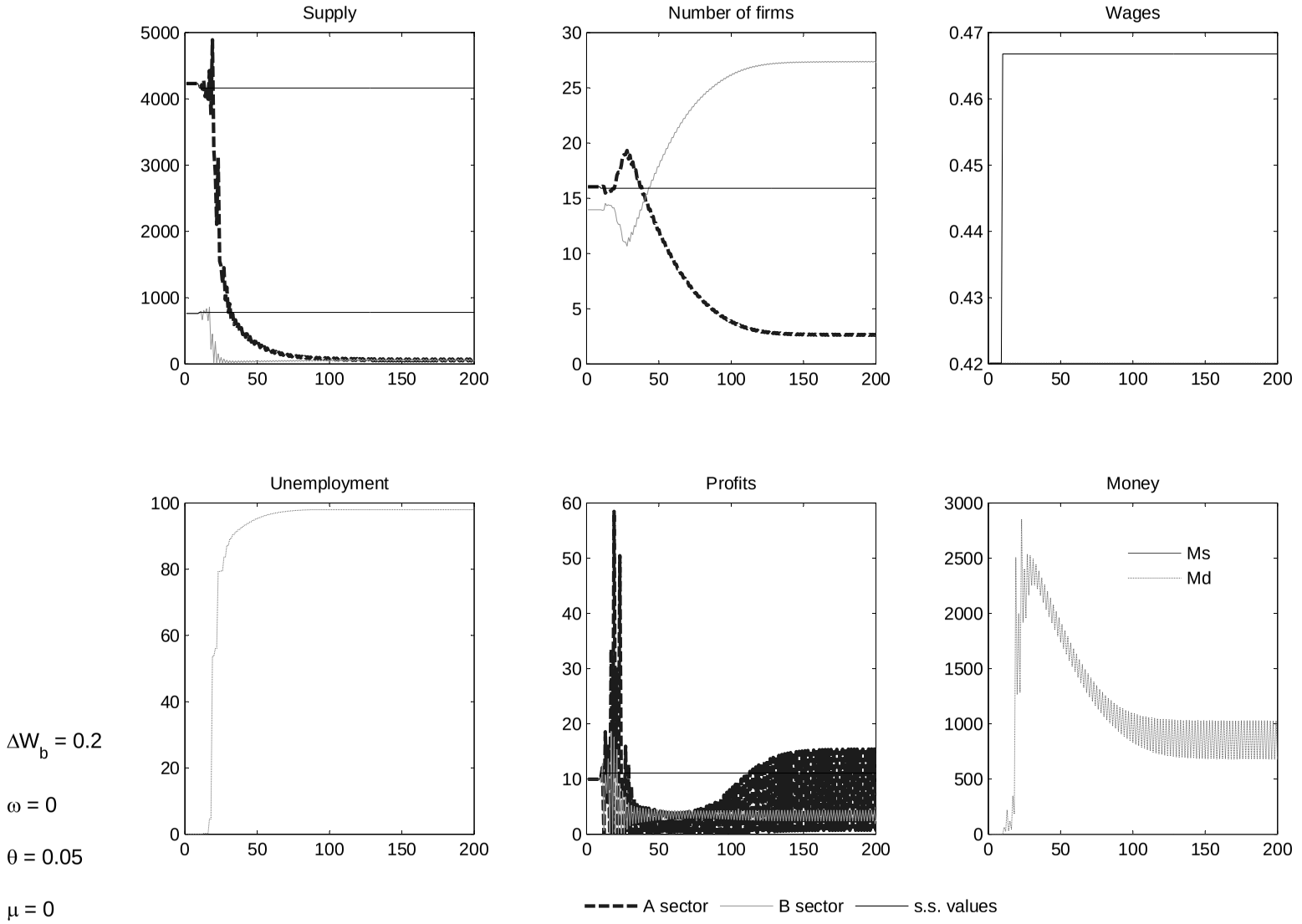

Figure 10: Positive shock to the basic sector. Fixed wages, low firm migration rates, binding credit constraints

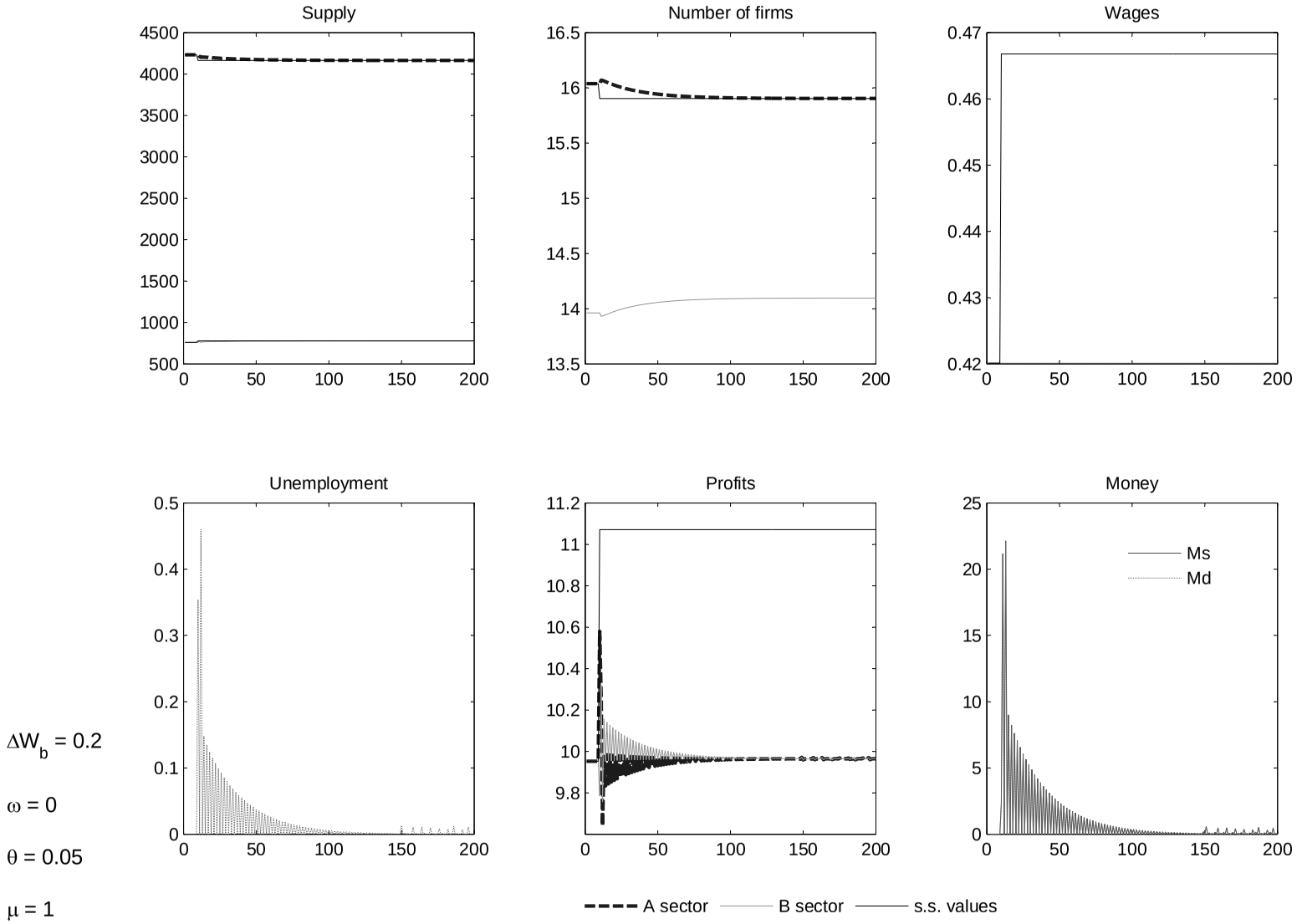

Figure 11: Positive shock to the basic sector. Fixed wages, low firm migration rates, Non binding credit constraints

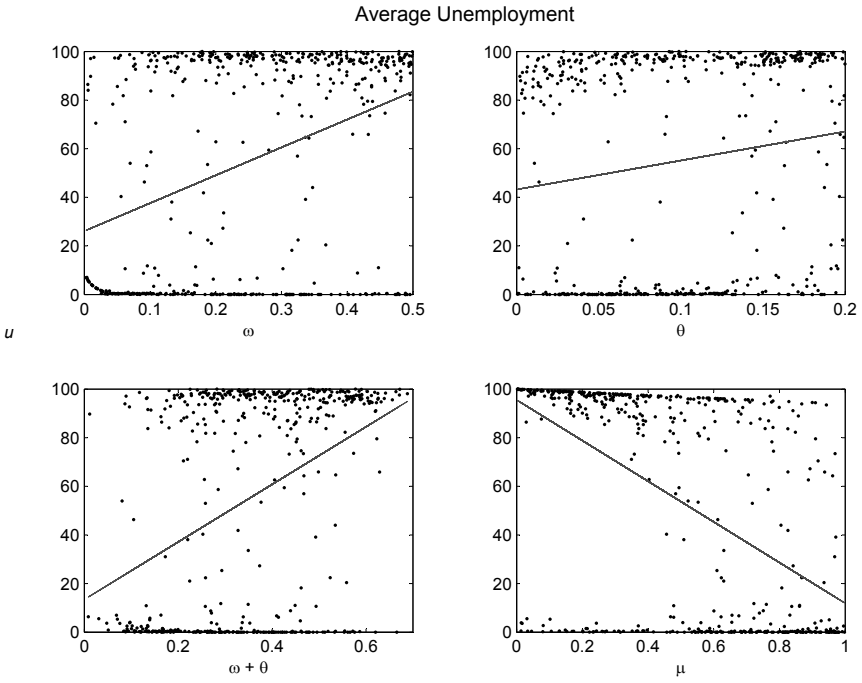

Figure 12: Montecarlo Simulation. Plot of final unemployment after the transition that follows a shock ($\Delta W_b = -0.2$) against randomly drawn values for $\mu \in [0, 1]$, $\theta \in [0, 0.2]$ and $\omega \in [0, 0.5]$

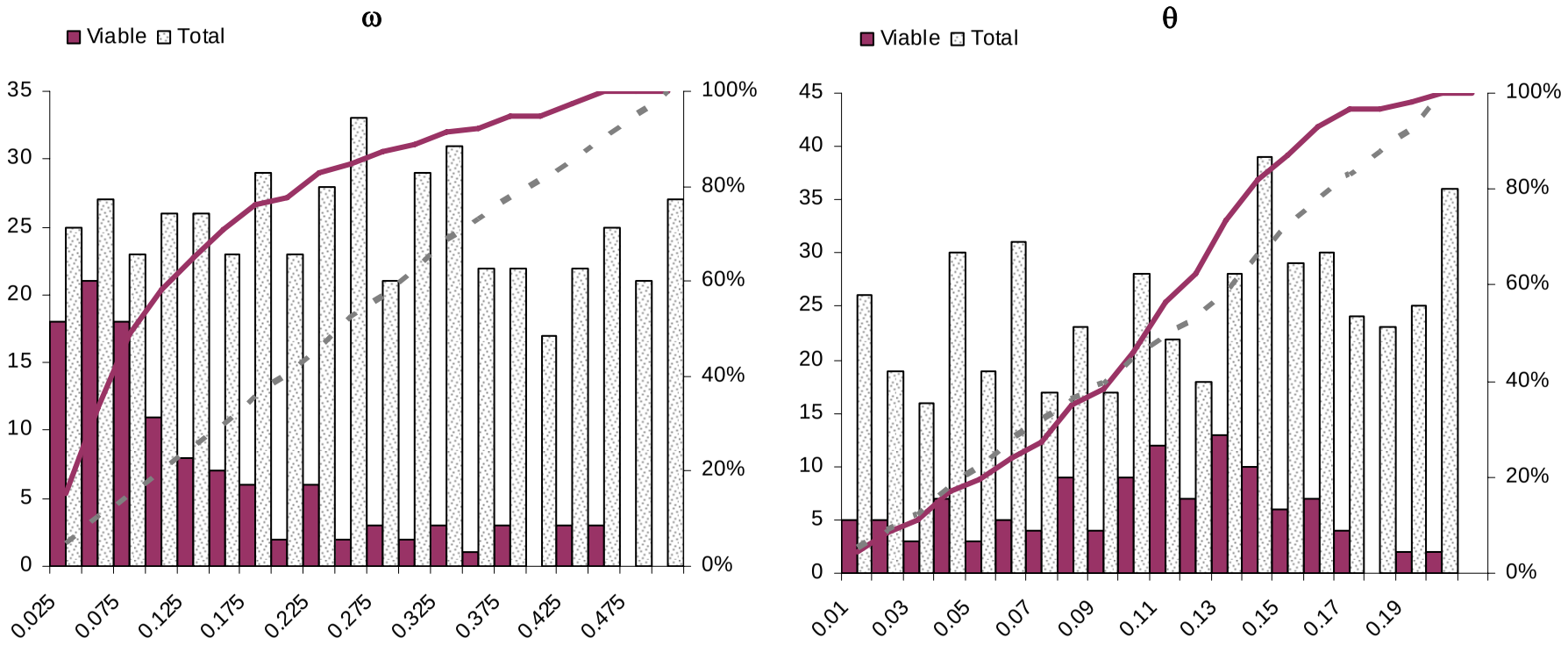

Figure 13: Montecarlo experiment distribution of wage and migration parameters for total sample and viable processes. Cumulate probabilities are also reported

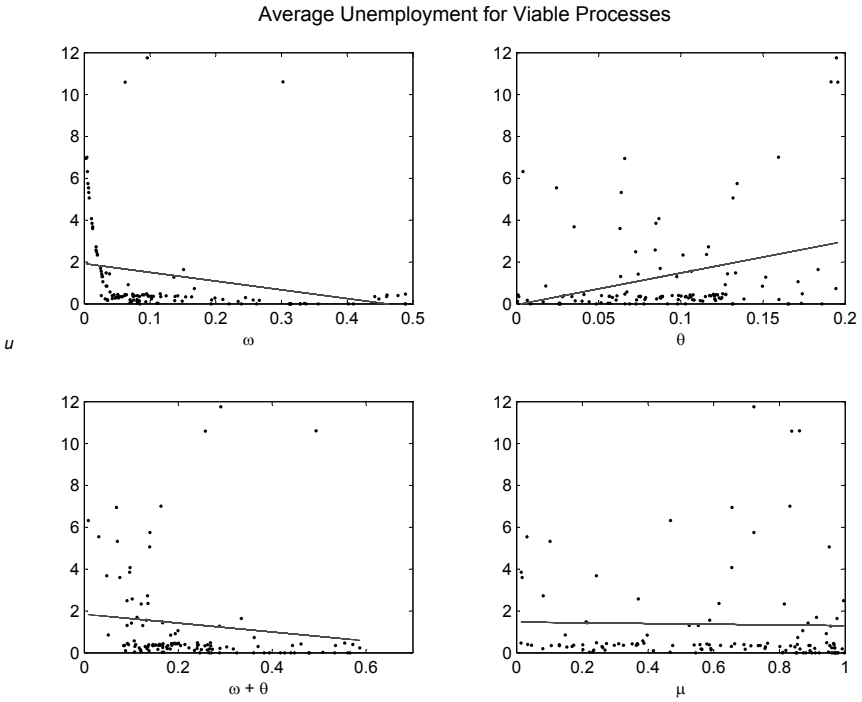

Figure 14: Montecarlo Experiment. The figure reads like figure 12, but only viable runs are reported

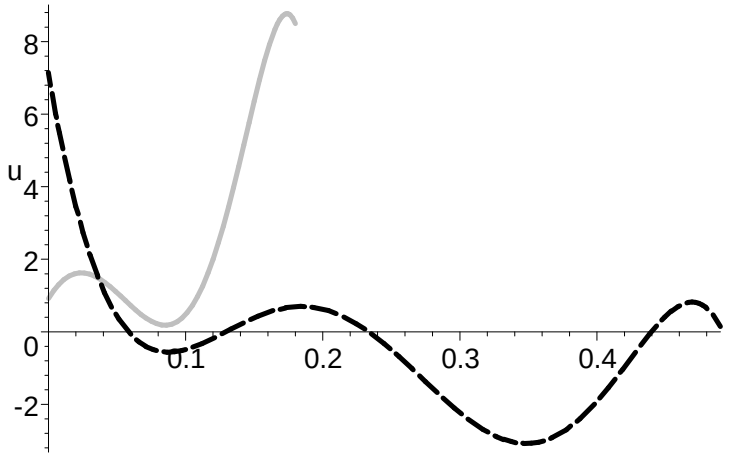

Figure 15: Plot of regression coefficients from table 2. Unemployment as a function of ω assuming that θ equals its median value $\theta = 0.08$ (black dashed line); unemployment as a function of θ assuming that ω equals its median value $\omega = 0.12$ (black dashed line).

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