Labor Markets in Heterogeneous Sectors

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Outline

- Introduction/Motivation
- Model
- Estimation/IRF’s
- Conclusions
Motivation

- Last 15 years, according to Alves and Correa (2013): the Brazilian Labor Market Dichotomy
  - Deep sectoral heterogeneity: Manufacturing × Services
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  - Deep sectoral heterogeneity: Manufacturing × Services

- Look at the data with more detail not only the Labor market, but also the Goods markets from the Manufacturing and Services sectors are deeply heterogeneous in Brazil.
  - Extensive and intensive margins of labor play different, but important roles.
Motivation

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  - Deep sectoral heterogeneity: Manufacturing × Services

- Look at the data with more detail not only the Labor market, but also the Goods markets from the Manufacturing and Services sectors are deeply heterogeneous in Brazil.
  - Extensive and intensive margins of labor play different, but important roles.

- Study is a first step at identifying those sectoral idiosyncrasies by means of a formal DSGE model intended for better estimation and policy advising.
Sectoral GDP
Participation Rate and Total Employment
(Over Working Age Population)
Sectoral Employment
(Over Working Age Population)
Hours per Worker
Fully Blown DSGE model

- I expand the DMP model (Diamond (1982), Mortensen (1982) and Pissarides (1985)) for a closed economy.
  - Search and matching frictions: equilibrium unemployment.
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**Contribution:** Endogenous decision to either leave the labor market or reallocate to a different sector (Manufacturing and Services), after an asymmetric stochastic training period.
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- Search and matching frictions: equilibrium unemployment.

**Contribution:** Endogenous decision to either leave the labor market or reallocate to a different sector (Manufacturing and Services), after an asymmetric stochastic training period.

- Sectors are asymmetric: firms are subject to sector-specific price stickiness and labor productivity.
Fully Blown DSGE model

- Thomas (2011) and Alves (2012): Firms simultaneously have specific labor force, post vacancy openings and explore both the intensive as the extensive margin of labor.
  - Induces richer dynamics in both the goods and labor market.
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Important Parameters

• $\delta^c$ and $\delta^\bar{c}$: Returning Rate at sector $c$ and Reallocating Rate from sector $c$ to $\bar{c}$.
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- $a_c$ and $\bar{b}_c$: Elast. unemp. matching function $m_{c,t} \equiv \eta_{c,t} \nu_{c,t}^{1-a_c} u_{c,t}^{a_c}$ and Worker’s bargaining power at sector $c$. 
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- $\varepsilon_c$: Labor productivity at sector $c$.

- $\alpha_c$ and $\iota_c$: Price rigidity and price indexation at sector $c$. 
Heterogeneous Labor Market

- Two sectors: $c \in \mathcal{F}_c \equiv \{m, s\}$ with size $w_c$;
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- End of period \( t \):
  - \( \ell_t^p, \ell_{m,t}^p, \ell_{s,t}^p \) members at working age.
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  - \( \ell^p_t \equiv (\ell_t + \ell^o_t) \), where \( \ell^p_t \) is exogenous, stochastic, stationary, \( E\ell^p_t = 1 \)
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  - \( \ell_t, \ell_{m,t}, \ell_{s,t} \) members in the labor market, employed or unemployed: endogenous;
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  - \( \ell^o_t, \ell^o_{m,t}, \ell^o_{s,t} \) members out of the labor market: endogenous;
  - \( n_t, n_{m,t}, n_{s,t} \) members are employed: endogenous.
Firms

- Firm $z$ costly posts $v_t^e(z)$ job vacancies at the end of each period, and hence $v_t(z) \equiv v_{t-1}^e(z)$. 
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- $n_t (z_c) \in (0, l_t)$ members employed in firm $z_c$. During each period, $m_t (z_c)$ workers are matched into firm $z_c$. 
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• $n_t(z_c) \in (0, l_t)$ members employed in firm $z_c$. During each period, $m_t(z_c)$ workers are matched into firm $z_c$.

• Production function: $y_t(z_c) = a_{c,t}A_t H_t(z_c) \epsilon_c$, where $H_t(z_c) = n_t(z_c) h_t(z_c)$. 

Probability: $\prod_{c,t} = (\Pi_{c,t}, 1) \bar{\epsilon}_{c}$. Decision: $p_t(z_c) = p_1(z_c) \prod_{c,t} \bar{\epsilon}_{c}$.
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- Probability $(1 - \alpha_c)$: price is adjusted to $p_t(z_c) = p_{t-1}(z_c)\Pi_{c,t}^{ind}$, where $\Pi_{c,t}^{ind} = (\Pi_{c,t-1})^{\ell_c}(\Pi)^{\ell_t}$. 
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- Firm simultaneously chooses $p_t^*(z_c)$, $v^e_t(z_c)$ and $n_{t+1}(z_c)$ to maximize its expected present discounted sum of nominal profits.
Firms

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- Firm simultaneously chooses $p_t^*(z_c)$, $v_t^e(z_c)$ and $n_{t+1}(z_c)$ to maximize its expected present discounted sum of nominal profits.
- Total real salary per period $\varpi_t(z_c) = w_t(z_c) h_t(z_c)$ decided by Nash bargaining, while hours per worker $h_t(z_c)$ are set to maximize total surpluses.
Household

- Utility: $u_t \equiv \mu_{u,t} \left( \frac{C_t - \nu_u \tilde{C}_{t-1}}{1 - \sigma} \right)^{1 - \sigma}$
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Aggregate Disutility:

\[ v_t \equiv \int_0^1 v_t(z) \, dz \]
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$H_t(z_c) \equiv n_t(z_c) h_t(z_c)$ is $v_t(z_c) \equiv \chi \frac{H_t(z_c)^{1+v}}{(1+v)}$
Household

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- Unemployment compensation: \( P_t \left( w_m \omega_{m,t} u_{m,t}^e + w_s \omega_{s,t} u_{s,t}^e \right) \)
Household

- Utility: $u_t \equiv u_{u,t} \frac{(C_t - \nu C_{t-1})^{1-\sigma}}{(1-\sigma)}$  
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- Unemployment compensation: $P_t (w_m \omega_m^{c,t} u_{m,t} \bar{u} + w_s \omega_s^{c,t} u_{s,t} \bar{u})$

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- Unemployment compensation: $P_t \left( w_m \omega_m^{c,t} u_m^{e,t} + w_s \omega_s^{c,t} u_s^{e,t} \right)$

- Members out of the labor market also consume $C_{c,t}$, but make no monetary contribution. However, being out of the labor market might be optimal if being unemployed is a burden

  - Being unemployed: extra disutility

    $v_{tu_t} \equiv w_m \bar{v}_m^{u} u_m^{e,t} + w_s \bar{v}_s^{u} u_s^{e,t}$ to the household
The representative household optimally chooses $C_t, A_{t+1},$ and $B_{t+1},$ as usual.
Household

- The representative household optimally chooses $C_t$, $A_{t+1}$, and $B_{t+1}$, as usual, and also $m_{c,t}^0$:
  - After not being matched, a mass $m_{c,t}^0$ of unemployed workers decide it is better not to search for a job, and possibly reallocate to the other sector.
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  - **Probability** $\delta^c$: worker returns to the labor force of sector $c$ in the beginning of next period.
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  - After not being matched, a mass $m_{c,t}^0$ of unemployed workers decide it is better not to search for a job, and possibly reallocate to the other sector.
  - **Probability $\delta^c_c$**: worker returns to the labor force of sector $c$ in the beginning of next period. **Probability $\delta^\bar{c}_c$**: she becomes fully specialized for working at sector $\bar{c} \neq c$ and reallocates in the beginning of next period.
Estimation

- About 15 parameters and steady state levels calibrated
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- 38 parameters and 13 standard deviations estimated using Bayesian approach (Flat Priors): 6,000,000 draws, discarding 5,000,000 as burn-in.
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- 13 observed quarterly variables, from 2003:Q1 to 2014:Q4:
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  - Working-age population, participation rate, employed workers at the manufacturing and services sectors (PME).
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  - Nominal interest rate.
### Estimation

<table>
<thead>
<tr>
<th>Intuition</th>
<th>Parameter</th>
<th>Mean (95% interval)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \frac{1}{\delta_m^m} \approx 2.1 q: ) average time to return to m</td>
<td>( \delta_m^m )</td>
<td>0.479 (0.457, 0.502)</td>
</tr>
<tr>
<td>( \frac{1}{\delta_s^s} \approx 1.1 q: ) average time to return to s</td>
<td>( \delta_s^s )</td>
<td>0.890 (0.846, 0.934)</td>
</tr>
<tr>
<td>( \frac{1}{\delta^* + \bar{\delta}_m^m (1 - \delta^* - \delta_m^m)} \approx 2.4 q: ) realloc time m ( \rightarrow s )</td>
<td>( \bar{\delta}_m^s )</td>
<td>0.796 (0.740, 0.857)</td>
</tr>
<tr>
<td>( \frac{1}{\delta^* + \bar{\delta}_s^s (1 - \delta^* - \delta_s^s)} \approx 10.3 y: ) realloc time s ( \rightarrow m )</td>
<td>( \bar{\delta}_s^s )</td>
<td>0.070 (0.000, 0.141)</td>
</tr>
<tr>
<td>How easy it is to find a job at m</td>
<td>( a_m )</td>
<td>0.966 (0.946, 1.000)</td>
</tr>
<tr>
<td>How easy it is to find a job at s</td>
<td>( a_s )</td>
<td>0.974 (0.957, 1.000)</td>
</tr>
<tr>
<td>Workers’ bargaining power at m</td>
<td>( \bar{b}_m )</td>
<td>0.939 (0.895, 0.989)</td>
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<tr>
<td>Workers’ bargaining power at s</td>
<td>( \bar{b}_s )</td>
<td>0.631 (0.577, 0.685)</td>
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<td>Reallocation costs from $m$</td>
<td>$\zeta_{mm}$</td>
<td>0.067 (0.050, 0.083)</td>
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<tr>
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<td>$\zeta_{ms}$</td>
<td>0.056 (0.036, 0.078)</td>
</tr>
<tr>
<td>Unemp Comp over Emp Salary at $m$</td>
<td>$\gamma^c_m$</td>
<td>0.033 (0.000, 0.069)</td>
</tr>
<tr>
<td>Unemp Comp over Emp Salary at $s$</td>
<td>$\gamma^c_s$</td>
<td>0.173 (0.049, 0.290)</td>
</tr>
<tr>
<td>Share of Unemp Workers from $m$</td>
<td>$\bar{p}_{ue}^{me}$</td>
<td>0.045 (0.000, 0.087)</td>
</tr>
<tr>
<td>SS Labor Tightness at $m$</td>
<td>$\theta^e_m$</td>
<td>0.861 (0.500, 1.230)</td>
</tr>
<tr>
<td>SS Labor Tightness at $s$</td>
<td>$\theta^e_s$</td>
<td>2.307 (1.848, 2.741)</td>
</tr>
<tr>
<td>Reciprocal Intertemp Elast Substit</td>
<td>$\sigma$</td>
<td>5.166 (3.423, 7.041)</td>
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<tr>
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<td>$\nu$</td>
<td>5.287 (3.502, 7.074)</td>
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<td>Labor productivity at $m$</td>
<td>$\varepsilon_m$</td>
<td>0.985 (0.968,1.000)</td>
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<tr>
<td>Labor productivity at $s$</td>
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<td>0.946 (0.895,1.000)</td>
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<tr>
<td>Price rigidity at $m$</td>
<td>$\alpha_m$</td>
<td>0.637 (0.561,0.702)</td>
</tr>
<tr>
<td>Price rigidity at $s$</td>
<td>$\alpha_s$</td>
<td>0.513 (0.402,0.618)</td>
</tr>
<tr>
<td>Price indexation at $m$</td>
<td>$\iota_m$</td>
<td>0.402 (0.316,0.487)</td>
</tr>
<tr>
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<td>0.065 (0.000,0.136)</td>
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Monetary Policy Shock
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4-Quarter Serv Relat Prices (%)

4-Quarter Serv Inf Rate (%)

Serv GDP (%)

Serv Output (%)

Serv Participation Rate (p.p.)

Serv Unemployment Rate (p.p.)

Serv Employment (p.p.)

Serv Hours per Worker (%)

Serv Unemp Duration (%)

Serv GDP per Total Hours (%)

Serv Salary (%)

Serv Wage (%)
Main Results

- Workers out of the labor market take longer to return in the Manuf sector ($\approx 6 \text{ m}$) than in the Serv sector ($\approx 3 \text{ m}$).
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- Workers from the Manuf sector find it *much* easier to reallocate to the Serv sector ($\approx 7 \text{ m}$) than workers from the Serv sector when reallocating to the Manuf sector ($\approx 10 \text{ y}$).
Main Results

- Workers out of the labor market take longer to return in the Manuf sector ($\approx 6 \text{ m}$) than in the Serv sector ($\approx 3 \text{ m}$).

- Workers from the Manuf sector find it much easier to reallocate to the Serv sector ($\approx 7 \text{ m}$) than workers from the Serv sector when reallocating to the Manuf sector ($\approx 10 \text{ y}$).
  - Results may be highly influenced from this particular sample.
Main Results

- Workers out of the labor market take longer to return in the Manuf sector ($\approx 6 \text{ m}$) than in the Serv sector ($\approx 3 \text{ m}$).

- Workers from the Manuf sector find it much easier to reallocate to the Serv sector ($\approx 7 \text{ m}$) than workers from the Serv sector when reallocating to the Manuf sector ($\approx 10 \text{ y}$).
  - Results may be highly influenced from this particular sample.

- Unemployed workers from serv sector find it easier get a job ($a_s \approx 0.974 > a_m \approx 0.966$) and ($\bar{\theta}_s^e \approx 2.31 >> \bar{\theta}_m^e \approx 0.86$), but have smaller power when bargaining for salary and hours ($\bar{b}_m \approx 0.94 > \bar{b}_s \approx 0.63$), and hence their salaries are closer to unemp compensation).
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  - Using Hosios efficiency condition ($\bar{b} = a$), the Manuf labor market also seems more efficient than the Serv labor market, i.e. $\bar{b}_m \approx a_m$, while $\bar{b}_s << a_m$. 
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- The model capture what is know as labor hoarding, for hours tend to fall much faster than employment after the shock.
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