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The structural transformation between manufacturing and services and the decline in the US GDP volatility ☆

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ABSTRACT

I construct a two-sector growth model to study the effect of the structural transformation between manufacturing and services on the decline in GDP volatility in the US. In the model, a change in the relative size of the two sectors affects the transmission mechanism that relates sectoral TFP shocks to endogenous variables. I calibrate the model to the US and show that, for given stochastic sectoral TFP processes in manufacturing and services, structural change generates a decline in the volatility of both aggregate TFP and GDP, in the volatility of each broad component of GDP (manufacturing consumption, services consumption and investment) and in the volatility of labor. Numerical results suggest that the structural transformation can account for 28% of the reduction in the US GDP volatility between the periods 1960–1983 and 1984–2005.

1. Introduction

The decline in GDP volatility that occurred in the US during the second part of the last century is a well documented fact. During the same period, the US also experienced a dramatic process of structural transformation, i.e. an increase in the size of the services sector relative to manufacturing. In this paper, I study the relationship between the structural transformation and the decline in GDP volatility in the US in the context of a two-sector growth model. The main finding is that structural change in the calibrated model can account for 28% of the decline in GDP volatility observed in the US between the periods 1960–1983 and 1984–2005.

Previous studies suggest that the process of structural transformation has quantitatively relevant implications for the growth rate (Echevarria, 1997) and for the level of aggregate TFP (Herrendorf and Valentinyi, forthcoming), while others show how the emergence of aggregate fluctuations from independent sectoral shocks depends on the structure of the economy (Carvalho, 2007). It is thus reasonable to expect that the structural transformation might also determine changes in aggregate TFP volatility and, in turn, in the volatility of GDP. In the US, manufacturing production is more intensive in intermediate goods and displays a larger volatility of TFP at the sectoral level with respect to services. These differences suggest that an increase in the size of the services sector may have two effects on the economy: (i) it may reduce aggregate

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Table 1
TFP volatility in manufacturing and services in the US.

	Sectoral TFP			Value added TFP		
Subperiod	1960–2005	1960–1983	1984–2005	1960–2005	1960–1983	1984–2005
Manufacturing	1.17%	1.35%	0.92%	2.93%	3.38%	2.30%
Services	0.74%	0.91%	0.51%	1.19%	1.47%	0.82%
Ratio	1.58	1.48	1.80	2.46	2.30	2.80

TFP volatility because of a composition effect; (ii) it may induce a change in the response of endogenous variables to shocks, because the structure of the economy has changed. Although the first effect is expected to imply a decline in GDP volatility, the second effect can have either a positive or a negative effect on the volatility of individual components of GDP, and so on GDP volatility.

The two-sector model presented allows me to study business cycles in an environment that is consistent with long-run structural transformation facts in the US. Structural change is generated by the interaction between exogenous TFP growth at the sectoral level and Stone–Geary preferences. This interaction implies that, in contrast with a standard one-sector growth model, the transmission mechanism of shocks to endogenous variables changes along the growth path, affecting the cyclical properties of the economy. In the calibrated model, for given stochastic sectoral TFP processes in manufacturing and services, structural change generates a decline in the volatility of both aggregate TFP and GDP, in the volatility of each broad component of GDP (manufacturing consumption, services consumption and investment) and in the volatility of labor. Thus, structural change has the same effect of an exogenous reduction in aggregate TFP volatility in a one-sector growth model.

The structural transformation has previously been investigated as a possible source of the GDP volatility decline in the US by using model-free counterfactual experiments.[1] The standard argument is based on the observation that services value added is the least volatile component of GDP. Thus, with the increase in the share of services, GDP volatility should have declined because of a composition effect. This paper instead, presents a general equilibrium model that allows the study of all the links between the structural transformation and GDP volatility. The model shows that a change in the relative size of manufacturing and services does not only imply a composition effect on GDP volatility. Instead, when the share of services in GDP increases, the volatility of *each* component of GDP declines in equilibrium.

The mechanism proposed in this paper should be regarded as complementary to others proposed in the literature to explain the decline in GDP volatility.[2] Apart from the structural transformation, explanations advocated to explain the GDP volatility decline are: improved inventory management techniques (Davis and Kahn, 2008), better monetary policy (Clarida et al., 2000), better financial instruments (Jermann and Quadrini, 2006), a decline in aggregate TFP volatility (Arias et al., 2007) and demographic change (Jaimovich and Siu, 2009). This paper also relates to the literature on structural change and economic performance, e.g. Ngai and Pissarides (2007), Rogerson (2008), and Herrendorf et al. (2009), among others. However, with the exception of Da-Rocha and Restuccia (2006), who study the role of the size of the agricultural sector in determining aggregate volatility, the effect of structural change on GDP volatility has received little attention in the theoretical literature.

The remaining of the paper is organized as follows: Section 2 analyzes TFP volatility in manufacturing and services in the US; Section 3 presents the model; Section 4 discusses the quantitative analysis; finally, Section 5 concludes.

2. Sectoral and value added TFP volatility

Table 1 reports the volatility of sectoral (gross output) TFP and value added TFP in manufacturing and services in the US.[3] The first column of Table 1 reports sectoral TFP volatility in the two sectors during the 1960–2005 period. Sectoral TFP in manufacturing is 58% more volatile than in services during the whole sample period 1960–2005, 1.17% versus 0.74%. The second and third columns of Table 1 report measures for two subperiods which are usually considered in the literature to compare GDP volatility, before and after 1984. For both sectors, sectoral TFP volatility declines between the two periods, although the services sector displays a decline of 44%, compared to a 32% in manufacturing. Furthermore, in both subperiods manufacturing displays a larger volatility with respect to services, 1.35% versus 0.91%, and 0.92% versus 0.51%, respectively.

The last three columns of Table 1 report value added TFP volatility for the two sectors. This measure depends on both sectoral TFP volatility and on the share of intermediate goods in gross output in the sector considered. In particular, for a given level of sectoral TFP volatility, value added TFP volatility is an increasing function of the share of intermediate goods in

[1] McConnell and Perez-Quiros (2000), Blanchard and Simon (2001), Stock and Watson (2002) and Davis and Kahn (2008) use fixed weights counterfactual experiments, while Alcala and Sancho (2003) use chain-weighted index numbers.

[2] According to Blanchard and Simon (2001), the reduction in GDP volatility in the US does not occur suddenly between the pre-84 and the post-84 periods, but is a process that started at least in 1950 and was interrupted in the seventies and mid-eighties. Interestingly, Buera and Kaboski (forthcoming) show that the rise in the services sector in the US is also a phenomenon that started around 1950. Also, it is worth noting that the decline in GDP volatility occurred in most G7 countries (Stock and Watson, 2003) as the increase in the share of services in GDP.

[3] Figures in this section are computed at a yearly frequency using Jorgenson Dataset, 2007. Series are logged and detrended using the Hodrick–Prescott filter before computing statistics. Manufacturing includes all non-services sectors. See Appendix A for details.