

Appendix: Variance Decomposition

Conceptual issues in detail

To first recap AY's argument as to why the observed trends of variances are compatible with trade barriers:

“The [reform period] Chinese data ... are compatible with a rise in trade barriers. [1] A growing diversity of nominal labor productivities could easily arise from growing interregional price disparities, which would increase both the variation of relative prices and, due to a decline in factor price equalization, the variation of real labor productivities. [2] A rise in the variance of labor allocations could come from increasingly perverse labor allocations, as provinces poured resources into areas of comparative disadvantage, a view that would also not be incompatible with the growing negative correlation between productivities and factor allocations.” (p. 1118)

Trying to sort through the various causalities, AY appears to make the following argument:

- (1) A rise in trade barriers causes an increase in inter-provincial price disparities. These cause (a) an increase in the variation of relative prices, and (b) a decline in factor price equalization and therefore an increase in the variation of real labor productivities. Increasing price dispersion and increasing variation in real labor productivity imply the observed increasing variation in relative nominal labor productivities. (The variance of the ln of the latter rises from 0.12 to 0.15 between 1978 and 1997.)
- (2) A rise in trade barriers causes provinces to pour resources into areas of comparative disadvantage, which causes perverse labor allocations, which in turn leads to the observed growing diversity of relative labor allocations. (The variance of the ln of the latter rises from 0.56 to 0.73.) Increasing labor allocation in a sector of comparative disadvantage goes hand in hand with a lowering of this sector's relative labor productivity. (The covariance falls from 0.01 to negative 0.17.)

But the causalities are problematic. (1) As argued earlier, trade barriers need not cause inter-provincial price disparities. AY has not even shown that price disparity increased between 1978 and 1997; at best, he has shown that price dispersion increased and decreased in individual years after 1986, that price dispersion in his series fluctuated within a very narrow range between 1990 and 1999 (without being able to document corresponding highs and lows in trade wars), and that price dispersion was particularly low in 1997 (when it is now supposed to be significantly higher than in 1978). Furthermore, the time pattern of inter-regional price disparities observed in China is well explained by institutional factors without the need to conjure up trade barriers.

But suppose price dispersion had indeed increased between 1978 and 1997, something for which we have no evidence. (a) If a province were to newly establish trade barriers and were to use these trade barriers to increase prices, then prices in all product categories—agricultural procurement, consumer goods, and industrial materials—would rise. The ratio of primary to

secondary prices remains unchanged, i.e., trade barriers (in contrast to AY's claim) imply a constant variation of relative prices. (b) But perhaps all provinces erect trade barriers only in favor of industry (as AY's economic rationale would suggest). Assume that each province increases industrial prices in such a manner that, across provinces, price dispersion of industrial materials changes in such a way as to cause an increase in the variation of relative prices (with the differential behavior of provinces asking for an explanation). At higher prices of industrial goods, presumably less is sold (in the limited provincial market with high trade barriers), i.e., real output falls. If, for a particular province, the percentage decline in secondary sector real output matches the percentage increase in secondary sector prices, relative labor productivity remains unchanged. Trade wars then imply constant variation in relative labor productivity over time, something AY found for the U.S, but not for China ("China's provinces became ... increasingly *dissimilar* in terms of sectoral productivities," AY, p. 1117).

(2) Trade barriers need not cause provinces to pour resources into areas of comparative disadvantage. Provinces may pour resources into areas of comparative advantage where profits could be highest; each province may protect only those of its industries where it has a potential comparative advantage.

If provinces were indeed found to pour resources into areas of comparative disadvantage (the evidence is lacking), this could be the result of central investment and development plans. A general economic development argument would suggest that different provinces, developing at different speeds, might move laborers out of agriculture each at their own pace (potentially increasing the variance of relative labor allocations). On the other hand, if AY makes the assumption that all provinces favor the secondary sector, needed for the first part of his argument to go through and an assumption that matches his economic rationale, the only conclusion that can be drawn is that relative labor allocations (as measured by primary divided by secondary sector employment) fall. What the variance of relative labor allocations does, cannot be determined without additional assumptions (which he does not specify).

Alternative explanation

One alternative explanation of AY's supposed findings, beyond those already offered immediately above, is the following. The reform period began with price increases for agricultural products mandated by the central government. Industrial relative to agricultural prices fell near-continuously from 100 in 1978 to 56.1 in 1997. Alternatively, the implicit deflator of the primary sector in the national income accounts stood at 549 in 1997 (up from 100 in 1978), that of industry at 234 and that of the secondary sector in total (covering industry and construction) at 254.¹ I.e., the planning period anti-agriculture "price scissors" (also noted by AY, p. 1096) decreased or disappeared. Due to this relative price rise in agriculture, with the primary sector in the nominator, relative nominal labor productivity rises. This rise is further helped by

¹ For the industry-agriculture comparison see *Statistical Yearbook 1998*, p. 302. The index is the "general price parity index of industrial and agricultural products" *gongnongye shangpin zonghe bijia zhishu*. (Industry and construction constitute the secondary sector; in 1978, construction accounted for 7.92% of secondary sector value added, and in 1997 for 12.92% (*Statistical Yearbook 2005*, p. 51).) For the national income accounts data see *Statistical Yearbook 2005*, pp. 51, 54.

the transfer of labor from primary to secondary sector, but retarded by increasing relative real output in the secondary relative to the primary sector. Figure 1a shows the rise in *average* relative nominal labor productivity as well as in its dispersion between 1978 and 1997. An increase in dispersion can simply come about through a nationwide uniform upward percentage change in relative nominal labor productivities across provinces. Or it could come about through differential price changes, possibly imposed by the center.

Economic development with increasing industrialization and tertiary sector development implies a transfer of labor out of the primary sector and into the other two sectors. Figure 1b illustrates the fall in *average* primary vs. secondary sector labor allocation between 1978 and 1997 and also suggests a decrease in dispersion, especially after excluding the outlier Tibet. (The lesser outlier of Jilin in Figure 1a makes no significant difference to the conclusion on the variance of relative nominal labor productivities.) In the paper I consequently make the point that the variance of relative labor allocations *decreases*, as seen in the figure here, in contrast to the variance of the *ln* of the relative labor allocations. If there were any need to provide an argument for an *increase* in the variance of relative labor allocations: the variance could increase if provinces' development speed differed significantly. Or it could fall, as it actually does, in contrast to AY's reading of the data, if, for example, the starting point is a nationally distorted production structure that gives rise to catching up effects.

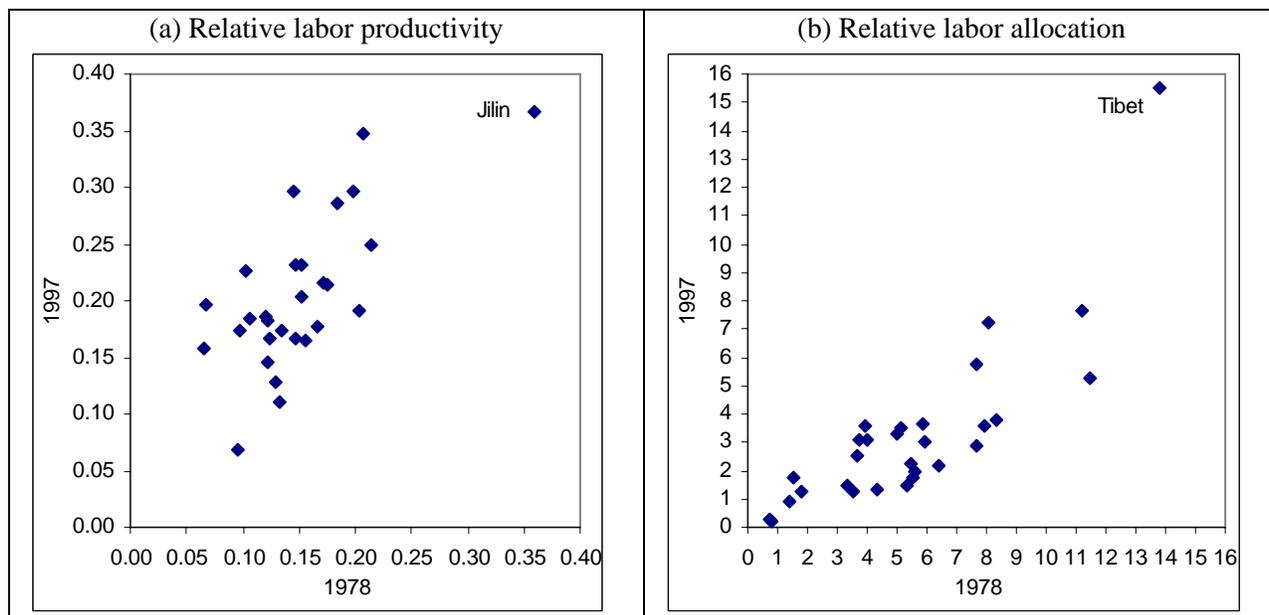
Time series values for China

Figure 2 reports the time series values of the variances and covariances of the natural logarithm (as in AY's presentation) for the primary vs. secondary sector ratios.

The natural logarithm findings are not only sensitive to the time period chosen but also to the choice of sectors.² Figure 3 reports the time series values of the variances and covariances of the natural logarithm (as in AY's presentation). In the period 1987-99, the variance of the nominal output ratio decreases from 0.18 to 0.09, the variance of relative labor productivities is almost unchanged at 0.04 and 0.06, relative labor allocations decrease from 0.16 to 0.11, and the covariance at negative 0.01 and negative 0.04 is near-zero in the two years. Following AY's logic, this is a pattern of decreasing trade barriers.

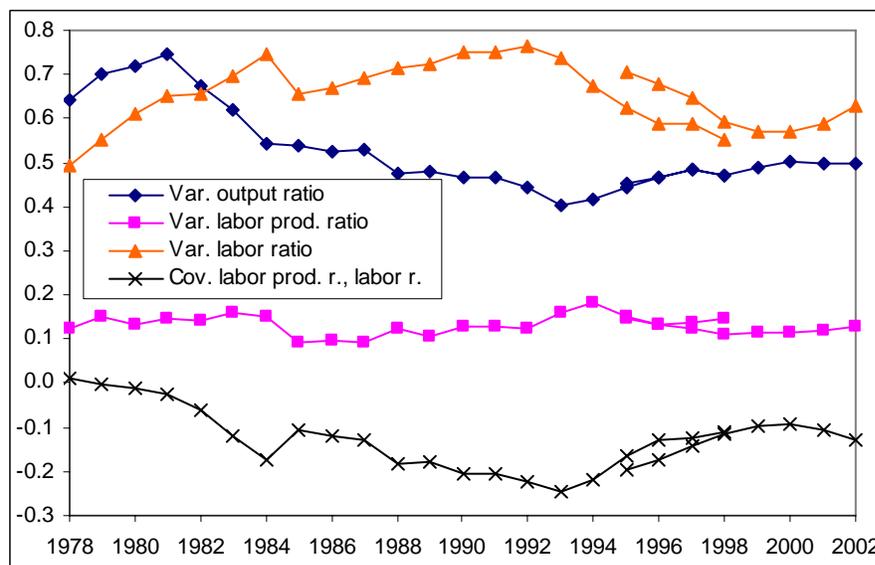
The absolute values in Figure 2 (mirroring the data presented by AY) differ from those of AY in his selected years for reasons that I do not know. AY's Lotus files are available on his website, but my Lotus program is unable to open them (the files appear created in a more recent version); similarly, Excel (recent version on Windows XP, or approx. 1998 version on Windows 98) cannot open them; StatTransfer 7 cannot read them; our department computer technician also had no success.

² AY only mentions in passing "relative output of primary to secondary industry, two predominantly tradable sectors" (pp. 1116f.). I do not understand in how far tradability for *both* sectors is needed. At any rate, only about 20-40% of all grain produced in China is actually traded and much of this trade could occur very locally (see Carsten Holz, 2006, Appendix 13); i.e., AY's predominantly tradable primary sector possibly involves very little trade. In as far as much of the labor flow between secondary and tertiary sector is likely to happen in urban areas, the household registration system is less likely to obstruct such flows.



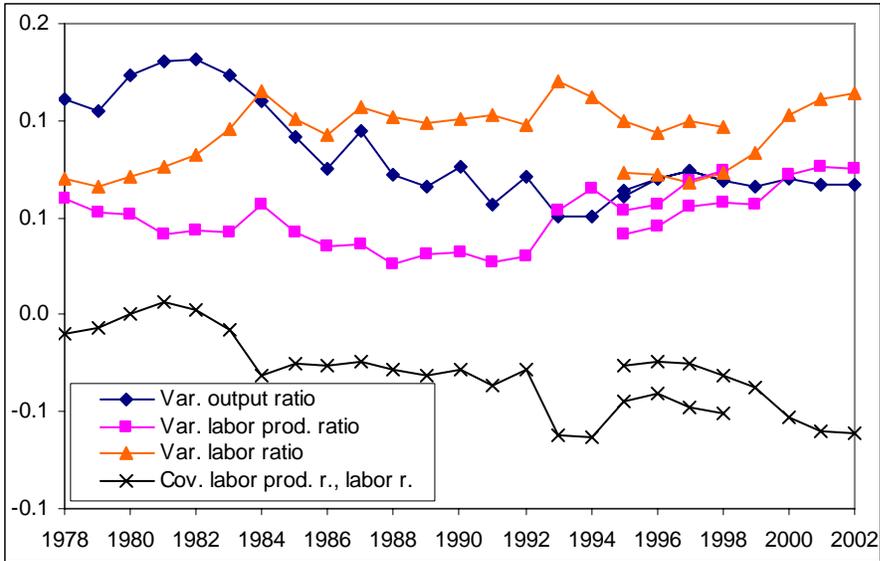
For data sources see the first table in the paper, with the second source for the 1997 labor data. The values are not in logarithmic form.

Figure 1. Ratios of Primary to Secondary Sector



For data sources see Table 1 in the paper. Tianjin is always excluded, and 1979-83 values are without Tibet. For the two variations of each series in 1995-98 see notes to Table 1 in the paper on the two labor series, and the appendix on labor data.

Figure 2. Variance/Covariance of the Natural Logarithm of Primary Vs. Secondary Sector Ratios



For data sources see Table 1 in the paper. Tianjin is always excluded, and 1979-83 values are without Tibet. For the two variations of each series in 1995-98 see notes to Table 1 in the paper on the two labor series, and the appendix on labor data.

Figure 3. Variance/Covariance of the Natural Logarithm of Secondary Vs. Tertiary Sector Ratios