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ABSTRACT

Earnings Inequality and Transition: A Regional Analysis of Poland*

In this paper we estimate the impact of transition on earnings inequality using data across Polish regions 1994-1997. Our central result is that earnings inequality is higher in regions that are more advanced in restructuring (higher labour productivity/job reallocation rates), controlling for unobservable regional fixed effects. At the national level rapid growth does not seem to be associated with earnings inequality. This aggregate relationship is shown to be misleading. The positive relationship between earnings inequality and the stage of transition across regions remains when we apply an infrastructure-deficit based instrumental variable approach to allow for reverse causality.

JEL Classification: D31, O15, E64, J6, J31

Keywords: Earnings inequality, transition, Polish regions

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Introduction

This paper is in the same spirit as Wei and Wu (2001) who model the relationship between urban and rural income inequality and trade openness across a hundred Chinese cities during the period 1988-1993. They argue that an in-depth case study of a particular country's experience across regions can be useful. Analysis based on cross-country studies can suffer major shortcomings. Atkinson and Brandolini (2001) worry about the compatability of data across countries. Use of dummy variables for pooled cross sections for data differences in each country may not be sufficient. In addition the comparability of living standards across countries in real terms using purchasing-power-parity adjustment cannot be done easily. Finally, to control for differences in legal and other institutions across countries can be very difficult. The use of fixed effects may not be enough as the impact of explanatory variables on measures of inequality may interact with such unobserved country specific effects.

Srinivasan and Bhagwati (1999) suggest that within a given country and over a relatively short time period, the culture, the legal system or other institutions can more plausibly be held constant. Furthermore, the comparability of data definition and collection method is, in principle, also higher within a single country than across multiple countries. In this paper we set out to estimate the impact of transition (using Amadeus Company Accounts data) on earnings inequality (using the Labour Force Survey) across Polish regions 1994-1997.

As in Wei and Wu (2001) we see that inferences based solely on national aggregate figures can be misleading. They find that cities more open to trade tend to have a lower urban-rural income inequality. At the national level urban-rural inequality and trade openness seem to have risen dramatically. Research at the

national level in Poland suggests that income inequality has remained relatively constant during transition. Evidence reported by Roland (2000) for Poland suggests that overall inequality has not risen during transition, reporting Gini figures of 0.26 in 1989 and 0.28 in 1997. Keane and Prasad (2000) report Gini estimates of earnings inequality, based on Household Budget Data, to be 0.292 in 1994 and 0.298 in 1997. Overall income inequality is documented at 0.262 and 0.276, respectively, for the same years. As graphed in Fig. 1, real GDP increased, on average, by 6.3 per cent per annum (ERBD 2000) over the period 1994-1997. Is it not surprising that this period of growth in Poland did not generate earnings inequality?

Kattuman and Redmond (2001) study income inequality in Hungary over the period 1987-1996. Coming from planning where incomes were compressed, they argue one should expect inequality would rise with progress in transition. The development path in countries coming from the planning era is fundamentally different to that described in the development literature. Kuznets (1955) seminal contribution to development and income inequality deals with a process of Industrialisation coming from an Agrarian society. Initial conditions in transition economies reflect, amongst other factors, over-sized Industry and Agriculture, inefficiency and specialisation across regions. This was also true of the associated human capital structures. Certain firms and workers would adapt to the market economy and others would not. Liberalisation of markets was expected to induce winners and losers and a spread in realised earnings[1]. Why did inequality not increase during transition in Poland? Are the aggregate figures misleading?

[1] In Industrial Organisation price dispersion can be modelled to be an outcome of competition in the market when individual consumers having different switching abilities. Borenstein and Rose (1994) provide empirical evidence for such in the US Airline Industry and Walsh and Whelan (1999) in the

Poland provides us with a "quasi" natural experiment. Polish regions inherited idiosyncratic industry and physical infrastructure coming out of the planning era. Huber and Scarpetta (1995) explain the growing polarisation in performance across Polish regions as an outcome of such. In addition, inter-regional job and worker flows (adjustments) have been virtually absent during transition (see Faggio and Konings, 1999, and Boeri and Scarpetta 1996) allowing independent developments across regions to persist over-time. While institutions and data sets are compatible across regions, the speed of transition and the evolution of earnings inequality could be expected to very different across the regions of Poland. Gora and Urszula (1999) identify a group of highly developed regions that have markedly higher earnings inequality, namely Warsaw, Katowice, Gdansk, Poznan and Krakow, when compared to the other 44 regions.

We document persistent and large differences in earnings inequality across regions. In addition, persistent and large differences in labour productivity, job reallocation rates and physical infrastructure deficits across the regions of Poland are documented. Our central result is that earnings inequality is higher in regions that are more advanced in restructuring (higher labour productivity/job reallocation rates) during the period 1994-1997.

We apply an instrumental variable approach to allow for reverse causality issues emphasised in Barro (1999). The instrumental variable approach is similar to that used in Wei and Wu (2001) and Frankel and Romer (1999). They use a geography-based instrumental variable to control for possible endogeneity of a region's trade openness. Geography turns out to be a good instrument for openness as participation in trade can be due to distance from a major seaport. We use a ranking of

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Irish Grocery Market. Liberalisation in the presence of firms and workers with different abilities to

regions based on infrastructure-deficits (density of phones, roads and railways across inhabitants) as our instrument. Transition to a decentralised market economy is much more likely to take place in regions that inherited good density in physical infrastructure. It is a kind of geography-based instrument in that we get the distance of firms and workers from important physical infrastructure. The positive relationship between earnings inequality and the stage of transition across regions remains when we apply an infrastructure-deficit based instrumental variable approach to allow for reverse causality. We describe the data we use in section I. In section II we document our econometric results. Finally, we make our conclusions.

Section I:

Infrastructure Deficits: We use data from the regional yearbooks to rank voivodships (polish regions) by four infrastructure indicators. Using a Borda electoral scheme, the sum of the best four rankings establishes the overall score for each region. Thus, the highest possible score is 4, when a region is always ranked number one, and the worst possible score is 196, when a region is always ranked last, at 49. The regions are then sorted in ascending order. Large discrete breaks in the score of voivodships determined the hiatus between our six regional groupings, leading to a regional taxonomy that we use to summarise our data. The full ranking is used when we apply an infrastructure-deficit based instrumental variable approach to allow for reverse causality in the inequality and speed of transition relationship in section II. The taxonomy in Table 1 reflects a systematic ranking of regions by their infrastructure development that persists during the transition period. With the exception of Warsaw and Lodz, eastern regions mainly inherited poor infrastructure, while western regions inherited superior infrastructure.

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adapt to the market economy should be expected to induce dispersion in earnings.

Polish Labour Force Survey Data: The data used for earnings is taken from the Polish LFS data for the years 1994 to 1997 in November. The Polish LFS is a quarterly household survey, February, May, August and November, starting in May 1992. The survey includes individuals older than 15 years and there is no upper age limit. The Polish LFS does not differ from the usual western survey. It contains more than 50 questions and allows one to distinguish between the employed, the unemployed and those not in the labour force according to ILO/OECD definitions. The total number of observations in each survey is approx 50,000. For each observation we use a record of regional location (voivodship) and wage/net earnings in the previous month from a main job measured in polish zloty. This allows us to construct average monthly wages for each voivodship and year. The Coefficient of Variation is the measure of earnings inequality by region and year that we use in our econometric section. Yet, one could use alternative measures. We show the consistency of our measurement with other measurements in Table 2, a correlation matrix of nine inequality measures for the 49 regions across the years 1994 to 1997.

In Table 3 we undertake a shift share analysis of regional earnings inequality. We note that the overall measure of earnings inequality does not change over the four years with a Gini of 0.23. Yet clear and persistent patterns emerge across regions grouped by their stage of infrastructure development. Shares of worker populations remain constant across groupings. Regional mean earnings and dispersion are higher in the top two groupings, particularly the first group of seven regions. The tendency for mean earnings and dispersion to rise over time for these groupings is offset by declines in relative income and dispersion in the other regions.

Amadeus Data: We use the Amadeus Company Accounts Data to construct regional job reallocation rates and real output per worker. The data consist of

incorporated companies across Agriculture, Industry, and Services that satisfy one of the following conditions: Employment > 100, Total Assets > 16 million US dollars and operating revenues > 8 million US dollars. The data set does exclude small firms. This is likely to underestimate the job reallocation rate but can be expected to track trends in local job reallocation rates. Given the population of large and medium sized firms one can expect it to capture real output per worker extremely well. The CSO in Poland do publish real GDP per capita data by region during the period 1995, 1996 and 1997. The correlation of real output per worker to real GDP per capita during these years is 0.96, 0.92 and 0.93 respectively. The econometric results using real GDP per capita, admit based on a smaller number of observations, are similar to those that use real output per worker across regions over four years.

We use the regional job reallocation rates constructed by Faggio and Konings (1999). They use the indices developed in Davis and Haltwinger (1992). We define a discrete measure of firm *i* growth over the period *t-1* to *t* in region *j* as follows:

$$g_{ijt} = \left(\frac{y_{ijt} - y_{ijt-1}}{(y_{ijt} + y_{ijt-1})/2} \right) \tag{1.1}$$

To examine the contribution of expanding and declining firms to the overall evolution of regional employment we sum the growth rates of each growing firm (POS), weighted by firm employment size, S_{ijt}, and sum the absolute growth rates of each declining firm (NEG) weighted by firm size S_{ijt},

$$\begin{aligned} POS_{jt} &= \sum_{i=1}^{n} S_{ijt} g_{ijt} \qquad if\ g_{ijt} > 0,\ and \\ NEG_{jt} &= \sum_{i=1}^{n} S_{ijt} \left| g_{ijt} \right| \qquad if\ g_{ijt} < 0. \end{aligned} \tag{1.2}$$

The annual net change, NET_{jt}, in regional employment is a net outcome that is induced by employment growth in expanding firms being offset by employment falls

in declining firms. The reallocation of jobs across firms within regional employment is captured by the RES_{jt} index calculated as follows:

$$\begin{aligned} NET_{jt} &= POS_{jt} - NEG_{jt} \\ RES_{jt} &= POS_{jt} + NEG_{jt} - \left| NET_{jt} \right| \end{aligned} \tag{1.3}$$

In Table 4 we document job reallocation rates, output shares and real output per worker across our regions grouped by infrastructure development. One feature to note is that output is heavily concentrated into the top two groupings. Real output per worker remains persistently higher in the top two groupings. As noted in Faggio and Konings (1999) there are striking differences in job reallocation rates within regions. For example in Warsaw the annual job creation rate was 4.7 per cent, the annual job destruction rate was 5.4 per cent, leading to an annual job reallocation rate of 9.7 per cent. Annually, nearly 10 per cent of employment is reallocated away from one set of firms towards another during each year of transition. In contrast in Zamoj, one of the weakest regions, the annual job creation rate was 2 per cent, the annual job destruction rate was 4 per cent, leading to an annual job reallocation rate of 4 per cent.

Job reallocation rates are pure compositional shifts in the firms that host jobs in the regional employment pool over a period of a year. Restructuring requires that traditional firms either exit or move towards their production possibility frontier and induce new firms to enter. Over time, more jobs should find themselves in either new or restructured firms. The job reallocation index captures this move to efficiency in firm populations extremely well. In Table 4 we observe that job reallocation is increasing over time across all our groupings of regions but again our first grouping clearly displays persistently higher job reallocation when compared to other groupings in the same year.

The raw data suggests that the transition paths within regions are inducing job reallocation, output per worker and earnings inequality to rise with each other. This is true over time by each regional grouping and across regional groupings. The proposed thesis is that within regions initial conditions, amongst other factors, dictate the speed of restructuring (this process involves the movement of workers away from inefficient jobs to efficient ones and increases in real output per worker) and induce earnings inequality in worker populations to rise.

Section II:

Generalised Two Stage Least Squares (GSLS) for Panel-Data: In what follows we provide econometric evidence for the assertion that earnings inequality is induced by advances in restructuring (increases in real output per worker or increases in job reallocation rates) across regions and time while controlling for simultaneity problems and the presence of other deterministic but omitted factors. We have information on 49 voivodships over a four-year period giving us a total of 196 observations. We estimate the impact of the (infrastructure-deficit) instrumented log of real output per worker, OPW_{jt}, and job reallocation rate, RES_{jt}, separately, in region j and period t, on the log of earnings inequality, EI_{jt}, in region j and period t while controlling for other factors. Models of earnings inequality within local labour markets (Coefficient of Variation) are written as follows,

Model I:

$$\ln EI_{jt} = \alpha + \beta_1 \ln OPW_{jt} + \beta_2 T_t + v_j + \varepsilon_{jt} \tag{2.1}$$

Model II:

$$\ln EI_{jt} = \alpha + \beta_1 \ln RES_{jt} + \beta_2 T_t + v_j + \varepsilon_{jt} \tag{2.2}$$

Unobserved heterogeneity in region *j* is controlled for by the inclusion of a unit specific residual, v_j, that is comprised of a collection of factors not in the regression that are specific to region and constant over time, for example, human capital and occupation structures of regions, varying participation rates of workers in the labour force, amongst other region specific factors. The random effect specification is justified on the basis of a Hausman (1978) specification test. The intercept and time dummies, in addition to the random effects, are also included in the regression to control for the evolution of unobservable macroeconomic deterministic factors over time. We instrument output per worker in model I and the job reallocation rate in model II with RANK, regional (random effects) and year controls to avoid an endogeneity problem. RANK takes on a value of 1 to 49, the public infrastructure ranking of the regions in Table 1.

In the first column of Table 5 and 6 we report 2SLS, rather then OLS, not allowing for unobserved heterogeneity in region *j*, justified on the basis of a Hausman test for simultaneity. The results of our G2SLS estimation procedure, allowing for unobserved heterogeneity in region *j*, is similar to that of Balestra, Varadharajan and Krishnakumar (1987), are presented in the second column of Table 5 and 6. The random effect specification is justified on the basis of a Hausman (1978) specification test.

G2SLS estimation in Table 5 and 6 produces a strong model specification on the basis of LM tests on the residuals. Compared to the 2SLS results we no longer have first-order autoregressive residuals and heteroscedasticity in the residuals. The level of earnings inequality is shown to be positively and significantly related to real output per worker in Table 5 and job reallocation rates in Table 6. Earnings are more

dispersed in regions advanced in transition. This result contrasts strongly to inferences based on aggregate data.

Conclusion

Using data across Polish regions, the paper documents that earnings inequality is higher in regions that are more advanced in restructuring (higher labour productivity/job reallocation rates), when controlling for unobservable regional fixed effects and applying an infrastructure-deficit based instrumental variable approach to allow for reverse causality.

This finding contrasts strongly with findings using data at the national level were rapid growth does not seem to be associated with rising earnings inequality. This aggregate relationship is shown to be misleading and highlights the mistakes that can be made from making inferences based on aggregate data, particularly in large countries.

Across the regions of Poland, the presence of firms and workers with different abilities to adapt to the market economy, allows market liberalisation to clearly induce earnings inequality during transition.

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Table 1
Taxonomy of the Inherited Public Infrastructure of Polish regions *

Group 6	Group 5	Group 4	Group 3	Group 2	Group 1
41. Ciechanowskie	32. Chelmskie	25. Czestochowskie	17. Walbrzyskie	8. Katowickie	1. Warszawskie
42. Ostroleckie	33. Kieleckie	26 .Bialostockie	18. Slupskie	9. Zielonogorskie	2. Szczecinskie
43. Krosnienskie	34. Radomskie	27. Plockie	19. Elblaskie	10 Legnickie	3. Poznanskie
44. Sieradzkie	35. Tarnowskie	28. Suwalskie	20 Gorzowskie	11. Bydgoskie	4. Wroclawskie
45. Przemyskie	36. Koninskie	29 Kaliskie	21. Lubelskie	12. Opolskie	5. Krakowskie
46. Bialskopodlaskie	37 Skierniewickie	30 Rzeszowskie	22 Torunskie	13. Koszalimskie	6. Lodzkie
47. Siedleckie	38 Nowosadeckie	31 Piotrkowskie	23. Leszczynskie	14. Bielskie	7. Gdanskie
48. Lomzynskie	39. Tarnobrzeskie		24 Pilskie	15. Jeleniogorskie	
49. Zamojskie	40. Wloclawskie			16. Olsztynskie	

* Ranked in ascending order by a rank score that sums the ranked positions in four indicators,

A: Number of Telephones in a region per 1000 inhabitants : A developed telephone network is an important part of the social capital infrastructure within a region. Measuring the number of telephones in a region per 1000 inhabitants is a simple indicator of the quality of public infrastructure in the region. The most (least) developed region has 391.5 (136.2) phones per 1000 inhabitants.

B: Number of Fax Machines in a region per 1000 inhabitants: Related to the provision of a telephone network is the availability of fax machines within a region. The most (least) developed region has 60 (16.9) fax machines per 1000 inhabitants.

C: Number of Railways in a region per 100km squared: Another simple indicator of the quality of public infrastructure in a region is the number of railways in that region per 100 km squared. The most (least) developed region has 21.8 (2.7) railways per 100 km squared.

D: Number of Public Roads per 100km squared: The quality of public infrastructure is also enhanced by the number of public roads per 100 km squared in a region. The most (least) developed region has 180.1 (43.4) per 100km squared.

Table 2

Correlation Matrix of 9 Measures of Earnings Inequality across Polish LFS Regions, 1994-1997

	Coef. of Var.	Gini	Rel. mean dev.	Std. Dev. of logs	Mehran	Piesch	Kakwani	Theil entropy	Mean log dev.
Coef. of Var.	1.00								
Gini	0.78	1.00							
Rel. mean dev.	0.75	0.99	1.00						
Std. Dev. of logs	0.62	0.92	0.91	1.00					
Mehran	0.70	0.98	0.98	0.95	1.00				
Piesch	0.82	0.99	0.98	0.89	0.96	1.00			
Kakwani	0.87	0.98	0.96	0.89	0.94	0.99	1.00		
Theil entropy	0.97	0.88	0.86	0.75	0.82	0.91	0.95	1.00	
Mean log dev.	0.86	0.97	0.95	0.92	0.94	0.97	0.99	0.94	1.00

Measures: relative mean deviation, coefficient of variation, standard deviation of logs, Gini index, Mehran index, Piesch index, Kakwani index, Theil entropy index, and mean log deviation.

Table 3

Summary Statistics on Earnings and Earnings Inequality by Group

	Population Share	Mean Earnings	Relative to National Mean	Earnings Share	Gini Co-efficient	Co-efficient of Variation
1994 Overall					**0.23**	**0.49**
Group 1	0.24	406.9	1.10	0.27	0.25	0.51
Group 2	0.29	388.1	1.04	0.30	0.23	0.46
Group 3	0.13	356.2	0.96	0.12	0.23	0.52
Group 4	0.12	347.7	0.94	0.11	0.21	0.42
Group 5	0.13	337.6	0.91	0.12	0.21	0.44
Group 6	0.09	326.2	0.88	0.08	0.21	0.44
1995 Overall					**0.23**	**0.50**
Group 1	0.24	532.0	1.09	0.26	0.26	0.57
Group 2	0.29	515.4	1.05	0.30	0.23	0.45
Group 3	0.13	460.1	0.94	0.12	0.22	0.46
Group 4	0.11	463.8	0.95	0.11	0.22	0.44
Group 5	0.13	438.7	0.90	0.12	0.21	0.42
Group 6	0.09	435.4	0.89	0.08	0.20	0.42
1996 Overall					**0.23**	**0.52**
Group 1	0.25	668.1	1.10	0.28	0.25	0.61
Group 2	0.29	636.0	1.05	0.30	0.24	0.46
Group 3	0.13	570.8	0.94	0.12	0.22	0.49
Group 4	0.11	566.3	0.93	0.10	0.22	0.48
Group 5	0.14	542.1	0.89	0.12	0.20	0.41
Group 6	0.09	549.2	0.90	0.08	0.19	0.42
1997 Overall					**0.24**	**0.58**
Group 1	0.25	745.2	1.11	0.28	0.27	0.66
Group 2	0.28	696.6	1.03	0.29	0.24	0.49
Group 3	0.13	630.4	0.93	0.12	0.21	0.45
Group 4	0.12	636.2	0.94	0.12	0.24	0.78
Group 5	0.13	618.5	0.91	0.12	0.21	0.45
Group 6	0.09	602.0	0.89	0.08	0.19	0.43

Source: Polish Labour Force Survey
Group 1 is the most developed and Group6 the least developed grouping in Public Infrastructure.

Table 4

Summary Statistics on Output and Job Reallocation by Group

	Output Share	Output per Worker	Job Reallocation Rate
1994			
Group 1	0.31	68	0.07
Group 2	0.27	60	0.04
Group 3	0.12	52	0.04
Group 4	0.12	51	0.03
Group 5	0.11	48	0.02
Group 6	0.07	38	0.01
1995			
Group 1	0.32	94	0.08
Group 2	0.28	82	0.06
Group 3	0.11	67	0.05
Group 4	0.11	65	0.05
Group 5	0.11	62	0.04
Group 6	0.07	52	0.02
1996			
Group 1	0.34	156	0.08
Group 2	0.27	113	0.06
Group 3	0.11	103	0.06
Group 4	0.11	99	0.05
Group 5	0.10	99	0.05
Group 6	0.07	70	0.03
1997			
Group 1	0.34	188	0.09
Group 2	0.27	144	0.07
Group 3	0.11	133	0.07
Group 4	0.11	130	0.06
Group 5	0.11	126	0.06
Group 6	0.07	92	0.04

Source: Amadeus Company Accounts Data
Group 1 is the most developed and Group 6 the least developed grouping in Public Infrastructure.

Table 5
Earnings Inequality and Output per Worker across Polish Regions 1994-97

	2SLS Model I	G2SLS Model II
	Log Earnings Inequality	**Log Earnings Inequality**
R^2 (Within)		0.05
R^2 (Between)		0.29
R^2 (Overall)	0.43	0.18
Constant	- 2.3 (7.1)*	-1.5 (6.7)*
Log Output Per Worker**	0.37 (5.1)*	0.19 (3.3)*
Region Dummies	YES	NO
Year Dummies	YES	YES
Random Effects	NO	YES
Observations	196	196
Hausman Random Effects Test		$\chi 2(3) = 0.3$
Hausman Simultaneity Test	$\chi 2(51) = 20.1$	$\chi 2(4) = 28.1$
Heterosced.	$\chi 2(52) = 62$	$\chi 2(52) = 8.6$
AR1	$\chi 2(1) = 1.5$	$\chi 2(1) = .03$

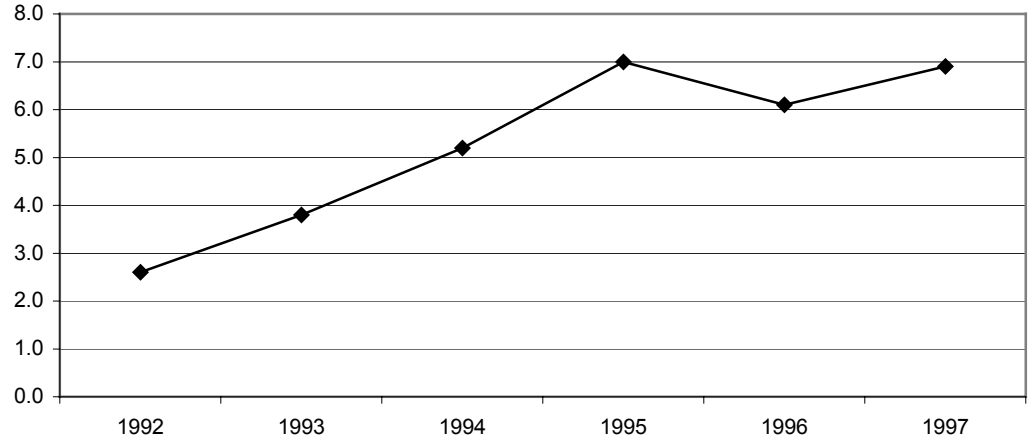
T-statistics in parenthesis, * indicates significance at the 5% level.
** Instruments include lnRANK, (random) regional effects and time dummies.

Table 6
Earnings Inequality and Job Reallocation across Polish Regions 1994-97

	2SLS Model I	G2SLS Model II
	Log Earnings Inequality	**Log Earnings Inequality**
R^2 (Within)		0.10
R^2 (Between)		0.22
R^2 (Overall)	0.66	0.19
Constant	-2.7 (1.2)	-0.3 (1.2)
Log Job Reallocation Rate**	0.08 (2.1)*	0.33 (3.9)*
Regional Dummies	YES	NO
Year Dummies	YES	YES
Random Effects	NO	YES
Observations	196	196
Hausman Random Effects Test		$\chi2(3) = 0.2$
Hausman Simultaneity Test	$\chi2(51) = 1.0$	$\chi2(4) = 38.1$
Heterosced.	$\chi2(52) = 45$	$\chi2(52) = 9.6$
AR1	$\chi2(1) = 7.1$	$\chi2(1) = 4.1$

T-statistics in parenthesis, * indicates significance at the 5% level.
** Instruments include lnRANK, (random) regional effects and time dummies.

Figure 1
Growth in Real GDP in Poland



Source: ERBD Transition Report 2000

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