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Canadian Great Depression**

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**Trade, Relative Prices, and the Canadian Great Depression**

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Canadian GNP per capita fell by roughly a third between 1928 and 1933. Although the decline and the slow recovery of GNP resemble the American Great Depression, trade was more important in Canada, as exports and imports each accounted for roughly a quarter of Canadian GNP in 1928. The fall in the trade share of GNP of roughly 30 percent between 1928 and 1933 was accompanied by a decline of over 20 percent in the relative prices of exports and imports relative to nontraded goods. We develop a three-sector small open economy model, where wages in the nontraded and import competing sectors adjust slowly due to Taylor contracts. We feed the relative prices of imports and exports from the data into the model, and find that the fall in traded goods prices can account for roughly half of the fall in GNP during the Canadian Great Contraction.

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# 1 Introduction

A common view is that fixed exchange rates (i.e., the gold standard) played a key factor in the international transmission of the Great Depression.<sup>1</sup> In this story, the transmission mechanism involves an explicit change in the price level which occurs (at least partly) via trade. However, surprisingly little work has attempted to quantify the impact of the fall in prices of traded goods during the Great Depression.

In this paper, we quantify the role of falling prices of traded goods in the transmission of the Great Depression to Canada. Canada is an interesting country to examine for several reasons. First, the path of real GDP per capita closely parallels that of the United States over 1928-1933, as well as during the protracted post 1933 recovery (see Figure 1). Second, it was (and is) a small open economy, with trade accounting for a large share of the economy. In addition, while it closely resembles the United States in many ways, it neither experienced a banking crisis, as [Haubrich \(1990\)](#) notes, nor did it implement many of the New Deal policies analyzed in [Cole and Ohanian \(2004\)](#).<sup>2</sup> Finally, there is substantial data to guide our analysis, since the Dominion Bureau of Statistics collected and published data on prices, quantities and employment at both the sectoral and aggregate levels.

Our first contribution is to document the substantial shifts in relative price and wages across industries. While the fall in the prices of commodities relative to finished goods during the Depression is well known (e.g., see [Lewis \(1949\)](#) and [Safarian \(1970\)](#)), the large rise in the price of nontraded goods relative to traded goods has remained largely undiscussed. We show that this shift in relative prices was accompanied by a shift in relative wages, as wages in the nontraded sector rose relative to traded industries. However, the fall in employment and real output varied substantially across industries, with employment in agriculture (which accounted for roughly a third of Canadian workers at the beginning of the Depression and was the largest source of exports) not declining despite a fall in wages of nearly 50 percent.

This large shift in wages and prices of nontraded relative to traded goods motivates our quantitative model. We develop a small open economy model with two traded sectors – one export and one import-competing – as well as a nontraded sector. Each of the sectoral goods is produced using an immobile factor (capital) and labor. The final consumption good is produced using all three sectoral goods. Although workers face a labor-leisure trade-off, we assume they cannot move between industries.<sup>3</sup> In our numerical experiments, we choose parameter values to match the sectoral

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<sup>1</sup>See [Temin \(1993\)](#), [Eichengreen \(1992\)](#), and [Eichengreen \(1995\)](#).

<sup>2</sup>See [Amaral and MacGee \(2002\)](#) for a comparison between the American and Canadian economies in the Great Depression.

<sup>3</sup>This is broadly consistent with the data, as there is little evidence of large flows of workers across industries. This

and trade shares from 1926, when agricultural yields were near historical averages.<sup>4</sup>

To illustrate the puzzle of the large shift in the relative price of traded to nontraded goods, we feed the prices of export and imported goods from the data into the model. We find that the model predicts a large decline in nontraded prices, and hence little change in relative prices or wages across sectors. The small fall in output is consistent with [Amaral and MacGee \(2002\)](#), who also find that the adverse movement in the terms of trade accounts for a small fraction of the fall in output during the Great Depression.

This discrepancy between the relative prices of traded and nontraded goods predicted by this frictionless model and observed in the data leads us to introduce (Taylor) nominal wage contracts in the nontraded and import competing sectors. In these sectors, hours worked are determined by the short side of the market, which for the shocks we consider implies they depend on the firms' real product wage. In the export competing sector, wages adjust to equate labor demand and supply.

Our benchmark counterfactual features two sets of shocks. The first are shocks to the prices of export and import competing goods, which we take from the data. Given the large share of agricultural products (especially wheat) in Canadian exports, we account for low agricultural yields by inputting a real shock to the export sector. This shock is calibrated to match the implications of variations in yields of the main field crops for average productivity in the export sector. The key wage rigidity parameters are calibrated so as to match the sectoral real product wages. Although we do not directly target it, our benchmark implies a path for the nontraded good price similar to that observed in the data. In turn, given that we feed in the prices of export and import competing goods, this implies that our benchmark average price is similar to that of the GNP Deflator.

We find that the large change in the relative prices of traded and nontraded goods can account for over half of the fall in output during the Canadian Great Depression. The fall in real output is driven by the import competing and nontraded sectors. In both sectors, the fall in output is driven by an increase in the real product wage which leads to a fall in labor. The model also implies a large decline in measured labour productivity.

Motivated by the large literature that assesses the contribution of deflation and wage rigidity to the Great Depression (see [Bordo, Erceg, and Evans \(2000\)](#)), we analyze a counterfactual where we feed in a monetary shock constructed to match the fall in Canadian M1. Since a contractionary monetary shock lowers prices, in this experiment we lower the magnitude of the international price shock so that we hit the same path for prices as in our benchmark. We find that adding the monetary shock has little impact on the predicted decline in output. This finding is consistent

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could reflect geographical frictions, as agricultural workers were disproportionately located in the Prairie Provinces.

<sup>4</sup>This is done to avoid calibrating to the historically high crop yields in 1928 or the initial decline in prices of traded goods.

with [Betts, Bordo, and Redish \(1996\)](#) and [Amaral and MacGee \(2002\)](#), who also conclude that real, rather than monetary shocks were the key driver of the fall in output in the Canadian Great Depression.

Our work is related to a long standing literature which argues that international trade was an important factor in the transmission of the Great Depression to Canada.<sup>5</sup> In early narrative work, [Safarian \(1970\)](#), [Mackintosh \(1964\)](#) and [Marcus \(1954\)](#) argue that the large decline in agricultural prices and exports played a significant role in the Canadian Great Depression. In contrast, [Amaral and MacGee \(2002\)](#) find that in a small open economy version of the standard international real business cycle models of [Backus, Kehoe, and Kydland \(1995\)](#), the shifts in the terms of trade account for only a small fraction of the decline in output over 1929 to 1933. This paper helps to reconcile these divergent views, as we show that the main effects of the fall in the international price of traded goods did not come about because of a shift in the terms of trade, but rather because of the large fall in the price of traded relative to nontraded goods.

Our paper contributes to a broader literature examining the international transmission of the Great Depression. In common with [Madsen \(2001\)](#), our results suggest that the decline in agricultural prices played a key role in the transmission of the Great Depression across countries. In recent work, [Cole, Ohanian, and Leung \(2007\)](#) revisit the conclusions of [Eichengreen and Sachs \(1985\)](#) and [Bernanke and Carey \(1996\)](#) that different timing in abandoning the international gold standard accounts for the observed cross-country deflations and output declines. They find evidence of the former, but not the latter causal relationship. Instead, they conclude that a decline in measured productivity accounts for roughly two-thirds of the decline in output, with the tradable sector playing an important role in the varying severity across countries. [Green and Sparks \(1988\)](#) argue that Canada's larger fall in output was due to its closer relationship with the United States, while Australia benefited from its close ties with England. Our work points to an important relationship between relative prices and the impact of the Great Depression.<sup>6</sup>

Our paper is also related to a broader literature exploring the impact of shifts in relative prices on the real economy. [Kose \(2002\)](#) uses a two-sector small open economy model to decompose the impact of shocks to the prices of developing economies, and finds that they account for a significant share of the volatility of GDP. [Ball and Mankiw \(1995\)](#) argue that relative price shocks combined

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<sup>5</sup>See, for examples, [Safarian \(1970\)](#), [Marcus \(1954\)](#), [Green and Sparks \(1988\)](#).

<sup>6</sup>Our finding is also consistent with [Amaral and MacGee \(2015\)](#), who conclude that real wage rigidities combined with deflation account for less than a fifth of the fall in output the U.S. Great Contraction. This work shares with [Cole and Ohanian \(2001\)](#) the view that taking sectoral heterogeneity in wages into account is important. Interestingly, [Ohanian \(2009\)](#) argues that the threat of unionization in manufacturing allowed President Hoover to convince manufacturing firms to keep their wages high while reducing the length of their workweek in exchange for protection from unions. Inputting the observed wages and workweek length in manufacturing and agriculture into a two-sector model, he is able to generate two-thirds of the fall in output by the end of 1931.

with slow price adjustment can have an impact similar to that of supply shocks. While our paper also examines the quantitative importance of relative price shocks, we differ both in our modeling approach as well as in our focus on the interwar period.

The remainder of this paper is organized as follows. Section 2 documents several key facts on relative prices, quantities and trade flows during the Great Depression. Section 3 outlines the small open economy model environment we use to quantify the effect of price shocks on the Canadian economy. Section 4 summarizes the findings of our counterfactual experiments. The final section offers a brief conclusion.

## 2 Key Facts from the Data

We begin by documenting several facts. First, there were large changes in *relative prices*, with a large fall in the relative price of traded to nontraded goods. In addition, the price of export goods fell relative to import goods. This shift in the terms of trade was largely due to a fall in the price of commodities relative to manufactured goods, as Canada was a net exporter of commodities (especially agricultural and forestry products) and an importer of manufactured goods. Second, these shifts in relative prices were accompanied by large shifts in relative wages across sectors, with nontraded wages rising relative to traded sector wages. Third, the traded good share of GDP in Canada fell during 1928-33. Finally, the large fall in the price of agricultural commodities did not lead to a reallocation of workers as there was little labor movement away from agriculture.

We also briefly outline some facts that help to rationalize these observations. First, we document that some (mainly nontraded) industries' prices were regulated and that these regulated prices adjusted slowly during the 1930s. Second, the large fall in commodity prices coincided with a large decline in the world price of agricultural and forestry prices. Third, this decline in agricultural prices during the late 1920s and 1930s was accentuated by substantial increases in tariffs and trade barriers in Western European countries. In addition, several large exporters moved to subsidize domestic production and export of commodities. Finally, the end of the 1930s witnessed the return of the USSR to world export markets.

### 2.1 Sectoral Shares of GNP and Trade

Before setting out facts on sectoral prices, wages and trade, we first outline our division of industries and their share of nominal GDP during the Great Depression.

We divide industries into nontraded, export and import-competing based on net trade flows. At the beginning of the Great Depression, Canada was a major exporter of agricultural and natural resource goods (both raw and processed). This leads us to classify Agriculture, Fishing and

Forestry and Mining as export industries. We also classify the manufacturing industries Food and Beverages and Wood and Paper as exporters, since processed goods such as (wheat) flour and wood pulp accounted for a significant share of exports. We classify the remaining manufacturing industries as import-competing, since Canada was a net importer of manufactured goods (particularly investment goods), mainly from the United States. Finally, the nontraded industries are Retail and Wholesale Trade, Government, Finance, Insurance and Real Estate, Transportation, Utilities and Communication, Services and Construction.

Figure 2 plots the nominal share of GDP for our three-sector classification. A key take-away from the figure is the large fall in the tradable sector share of GDP over 1926-33. This was mainly due to a decline in the export industries, particularly agriculture, whose share of GDP fell from roughly 17% over 1926-28 to less than 10% by 1933. While the government share of GDP did rise during the Depression, it played a small role in the rise in the nontradable share of GDP, as the share of government in GDP only rose from 5% in 1929 to roughly 7% over 1933-39.

## 2.2 Decline in Trade

The decline in Canadian exports and imports between 1928 and 1933 figures prominently in several accounts of the Canadian Great Depression.<sup>7</sup> As can be seen in Figure 3, the export share of GNP fell by roughly a third during the Contraction before recovering in the late 1930s.<sup>8</sup> This was not driven solely (or even mainly) by the United States. While the United States was Canada's largest trading partner in 1929 (having surpassed the United Kingdom in 1927), it was not as predominant a trading partner as today. Exports to the United States accounted for just over 8 percent of Canadian GNP over 1926-1928, with exports to other countries (mainly the United Kingdom) accounting for roughly 14 percent.<sup>9</sup> While total trade with the United States fell by more than half between 1929 and 1933, net exports to the United States increased.

Canadian exports were concentrated in commodities, with the top 5 exports accounting for nearly half of all exports in 1927 and 1928, although this share fell to roughly 35 percent over 1935-38. Table 1 reports exports of goods, as well as the value of the top three export goods in the late 1920s relative to GNP. The United Kingdom was the key export market for the largest Canadian export: wheat, as well as for wheat flour. Prior to the Great Depression, exports of wheat and wheat flour were between 7 and 8.5 percent of GNP, roughly a third of total exports.

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<sup>7</sup>See Safarian (1970), Marcus (1954) and Green and Sparks (1988).

<sup>8</sup>Figure 3 plots the export and import data reported in Historical Statistics of Canada Series F14-32. These series includes interest and dividend earned (paid) by Canadian residents. The narrower measure of trade in goods reported in Series G381-385 features an even larger (relative) fall.

<sup>9</sup>By the end of the twentieth century, exports to the United States accounted for roughly 30 percent of Canadian GNP, and over 80% of total exports.



Table 1: **Main Canadian Exports**

Year	Exp/GNP	Wheat Exp/GNP	Paper Exp/GNP	Flour Exp/GNP
1926	24.7%	7.1%	n.a.	1.4%
1927	22.0%	6.1%	2.2%	1.1%
1928	22.4%	7.2 %	2.3%	1.1%
1929	19.1%	4.1%	2.4%	0.9%
1931	12.7%	2.5%	2.3%	0.4%
1933	15.2%	3.5%	2.0%	0.5%
1935	17.1%	3.2%	2.0%	0.4%

Source: Wheat, Paper and Flour are from various issues of *Trade of Canada: Imports for consumption and exports*.

Note: Exports (Exp) pertains to goods only.

The largest exports to the United States were wood products, particularly printing paper as well as wood pulp, which together were roughly 3 percent of GNP in 1927.

The fall in the value of the top exports reflects both a shift in relative prices, as well as a decline in the real (physical) quantity of goods exported. Although wheat exports were impacted by low crop yields, real wheat exports (in bushels) only fell by 25 percent between 1927 and 1933. In contrast, the nominal price fell by over half.<sup>10</sup> The fall in flour exports was due to both the quantity exported and the price falling in half by 1933. In contrast, prices and quantities for paper and wood pulp fell by just under 30 percent by 1933 from pre-depression levels.

Imports also fell dramatically, although the fall in prices was smaller than for exports, as the terms of trade moved adversely. This reflects the fall in the price of commodities to manufactured goods, as Canada was a net importer of manufactured (especially investment) goods. In addition, some goods were subject to tariff increases as we discuss in Section 2.5.2.

Unsurprisingly, the fall in net exports impacted the trade balance and the current account. Prior to the onset of the Great Depression, both the trade balance and the current account were in surplus. By 1929, they had both turned to a deficit, moving back to balance by 1933.

### 2.3 Large Changes in Relative Prices and Wages

The Canadian Great Depression coincided with a substantial deflation over 1929-33 (see Figure 4).<sup>11</sup> Of the three indices plotted in Figure 4, the GNE deflator implies the smallest deflation over 1929-1933, declining by roughly 18%. The CPI/COLI suggests a slightly larger deflation of

<sup>10</sup>For the top five exports, prices are unit values based on export data.

<sup>11</sup>The Gross National Expenditure Deflator's base period prices (weights) for 1926-1947 are from 1935-39.

roughly 23 %, due to a larger decline between 1932 and 1933.<sup>12</sup> The Wholesale Price Index (WPI) experienced the largest decline, falling by roughly 30%.<sup>13</sup>

These aggregate price indices suggest that the deflation of the early 1930s was accompanied by large changes in *relative* prices, as the larger decline in the WPI compared to consumer prices, or to the GNE deflator, points to a rise in the relative price of nontraded to traded goods. To verify this conjecture, we use the GNE deflators for imports and exports to back out the implied deflator of nontraded goods.<sup>14</sup> As Figure 5 shows, the implied price index for nontraded goods rises slightly during the first years of the Depression, and remains well above the prices of traded goods.

Is this estimate of the shift in traded to nontraded prices reasonable? As a check, we use consumer price data based on sub-indices of the COLI. To construct a proxy for traded goods, we use the categories for Food and Clothing, as food and clothing were both widely traded during the Interwar period. Rent is a natural fit for the nontraded category. The two other nontraded categories are Fuel and Lighting and Miscellaneous/Sundries. Fuel and lighting comprised 6% of the COL, and was based on consumer prices of coal (53%), coke (9%), wood (16%), gas (9%) and electricity (13%). The larger category was Miscellaneous (Sundries), which comprised 26% of the COL. Most of the goods included in this category were services.<sup>15</sup> This leads us to group these three categories as nontraded. As can be seen from the last two columns of Table 2 (and Figure 6), this also implies a large decline in the price of traded to nontraded goods.

The key take-away from these data is that the large decline in the global price of commodities (especially agricultural commodities) was a key factor in the Canadian deflation of the early 1930s. More importantly, this resulted in a fall in the price of traded export goods (mainly commodities) relative to manufactured and nontraded goods.

## 2.4 Nominal Wages and Employment by Sector

The pattern of shifts in relative prices across industries also holds for wages. Figures 7 and 8 plot Dominion Bureau of Statistics estimates of average wages for wage earners in traded and nontraded industries, respectively. The largest declines in nominal wages occurred in export-intensive agricul-

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<sup>12</sup>The Dominion Bureau of Statistics produced a cost of living indices (COLI), which later became the consumer price index (CPI). We make use of the sub-indices of the COL below, since these were reported by DBS.

<sup>13</sup>The WPI is an index of the prices of raw and processed materials, semi-finished goods and fully manufactured products. While most prices are for large transactions, not all are at the "wholesale" level. Both the base period weights as well as the number of goods in the WPI varied during the interwar period, with the different series being linked in overlapping years. The index spanning 1913-1925 is based on 1913 weights for 236 goods, while the 1926-1934 period uses base weights from 1926 for a basket of 502 commodities. The index was updated in 1935 with weights based on 1935-39 for 604 goods.

<sup>14</sup>More precisely, we use the GNE deflators for imports and exports together with the GDP shares of each of the three sectors we defined in section 2.1 to back out the implied deflator for the nontradable sector.

<sup>15</sup>See the appendix where the weights for the various sub-components are summarized in Table 4.

Table 2: **Price Indices (1926=100)**

Year	GNE Defl.	WPI Imp	WPI Exp	COLI							
				All	Food	Cloth	Rent	Fuel	Sundries	Traded	NT
1928	98.4	96.1	94.2	98.9	98.6	97.4	101	96.9	98.8	98.2	99.4
1929	99.5	94.2	92.2	99.9	101	96.9	103.3	96.4	99	99.5	100.4
1930	97.0	83.7	77.4	99.2	98.6	93.9	105.9	95.7	99.4	96.8	101.5
1931	91.0	72.4	60.5	89.6	77.3	82.2	103	94.2	97.4	79.1	99.2
1932	82.5	70.5	54.9	81.3	64.3	72.3	94.7	91.4	94.6	67.3	94.3
1933	81.1	73	55.2	77.5	63.7	67.1	85.1	87.7	92.6	65.0	89.2

Source: GNE deflator is from Historical Statistics of Canada.

COLI and WPI data is from *Prices and Price Indexes* (1913-1938, 1913-1930) and *Canada Year Book 1940*, p 817.

tural and forestry industries. In contrast, mining and manufacturing, which contained substantial import-competing industries, declined substantially less. The nontraded industries' nominal wage rates show much smaller declines, although the decline in construction wages is similar to manufacturing.

The data on employment is more limited. The percentage of the total population employed in agriculture and non-agriculture is plotted in Figure 9. As can be seen from the figure, agriculture accounted for over a third of total employment. The counterpart to the large decline in nominal wages in agriculture is the small decline in total employment. Despite the fact that the share of agriculture in GDP fell by roughly half from the 1920s to the 1930s, the level of employment in agriculture remained roughly constant after 1931. As a result, most of the decline in employment after 1930 can be attributed to the non-agricultural sector.

## 2.5 Trade Policy and Exchange Rates

The large shifts in relative prices may signal significant shocks to policy. We briefly summarize some key facts and provide some background on the role of exchange rates, trade policies and regulation of some nontraded good sectors that offer insights into the underlying factors behind the large shift in relative prices documented above.

### 2.5.1 Nominal Canada-U.S. Exchange Rate during the Interwar Period

Prior to World War I, Canada and the United States were on the gold standard, with a par value of one Canadian dollar for one U.S. dollar. In 1914 (shortly after entering World War I), Canada suspended convertibility of the dollar into gold and did not (formally) return to the gold standard until July 1926. When it did return, dominion notes (Canadian dollars) and U.S. dollars were both

convertible into gold at the rate of \$20.67 per ounce. Although the United States also suspended convertibility during the First World War, it returned to the gold standard in June 1919.

Figure 10 plots the Canada-U.S. nominal exchange rate, expressed as Canadian dollars per U.S. dollar, over the 1913-1940 period. The Canadian dollar depreciated by more than 10 percent on two occasions - once after WWI and in 1931. The depreciation of 1931 came roughly two years after Canada *de facto* left the Gold Standard, as gold shipments were suspended in January 1929 (Bordo and Redish, 1990). Despite the suspension of convertibility, the Canadian government took steps to prevent depreciation of the dollar, motivated in part by a wish to maintain access to American capital markets to refinance Dominion debt (Shearer and Clark, 1984). As a result, the government maintained the advance rate at its 1928 level throughout 1930, despite the fall in world rates. This policy was ultimately abandoned after the British left the Gold Standard in October, 1931. Subsequently, the Canadian dollar depreciated relative to the U.S. dollar by approximately 15 percent, before beginning to appreciate after the United States left the Gold Standard in March of 1933. In April of 1933, Canada “officially” confirmed the non-redemption of notes for gold. The Canadian currency reached parity again in November 1933, although the exchange rate fluctuated somewhat until 1935, and remained near parity until October 1939, when the Canadian dollar again depreciated relative to the U.S. dollar.

## 2.5.2 Tariff and Non-Tariff Barriers

An important factor behind the shift in relative prices of export and import goods was the rise of trade barriers in Canada and abroad. Particularly important for Canadian exports was the dramatic rise in continental European barriers to the imports of agricultural goods (Ezekiel, 1932). These barriers arguably helped lower the international price of Canadian agricultural exports, and amplified the impact of the return of Russia to the world market for agricultural exports.

Although U.S. tariff policy during the Great Depression is widely discussed, the impact of the Hawley-Smoot Tariff act of June 17, 1930 on Canada was arguably smaller than European developments. Hawley-Smoot raised U.S. tariffs on over 20,000 imported goods, with the primary Canadian exports affected being wheat, flaxseed, millwood, cattle, milk products, wool, and fish.<sup>16</sup> While the United States was a major export destination for some of these goods (particularly live cattle), for others, such as wheat, the U.S. market accounted for a small share of exports.

Canada also moved to increase trade barriers during the Great Depression. Canada responded to the Hawley-Smoot act by preemptively imposing tariffs on 16 products that together accounted for roughly 30% of U.S. exports to Canada. The main U.S. exports affected by Canadian duties

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<sup>16</sup>See McDonald, O’Brien, and Callahan (1997).

were potatoes, eggs, fresh meats, butter, wheat, flour, and rolled oats. In addition, the Ministry of National Revenue was provided with the authority to assign higher values to imported goods, and fixed currency valuations were used to counteract currency dumping.<sup>17</sup> The increase in average tariffs from 1928 to 1933 was roughly 20 percent. Similar sized increases were put in place for imports from the United States and the United Kingdom, who accounted for 68 and 15 percent of Canadian imports in 1929, respectively.

The increases in Canadian tariffs were largely undone by 1937, as a result of trade agreements negotiated during the 1930s. Tariffs on imports from Commonwealth countries were lowered after 1932 as a result of treaties negotiated at the Ottawa conference. In 1935, Canada and the United States negotiated a bilateral trade agreement (the United States-Canada Trade Agreement) which came into effect on January 1, 1936. This agreement lowered duties on roughly three-fourths of the dutiable goods imported from the United States in 1929, and were significant for iron and steel products as well as machinery (Goldenberg, 1936).<sup>18</sup>

### 2.5.3 Regulation: A Partial Explanation for the Small Decline in Nontraded Prices

While the fall in traded goods' prices reflected global market trends, nontraded prices were determined endogenously. This raises the question of what frictions could be responsible for the small decline in nontraded prices during the Great Depression.

A partial explanation for this slow adjustment is government regulation. Although Amaral and MacGee (2002) document that there was no NRA-type intervention by Canadian governments, nontraded transportation industries were subject to price regulation in Canada, both directly and indirectly via government ownership. These industries accounted for 10 – 13% of nominal GDP in Canada (and the United States), or roughly a fifth of the nontraded sector. This regulation involved all three levels of government. For example, city tramlines were often directly or indirectly regulated by municipal governments.<sup>19</sup> Public utilities and railway prices were also regulated in both Canada and the United States, and these prices were not adjusted downwards during the Great Depression. Public utilities such as power companies and local railways were regulated by Provincial bodies during the interwar period in Canada (Currie, 1946). Although little academic work has explored the behavior of Canadian utilities during this period, Sumner (1939) documents that the prices of a variety of public and utility goods did not decline (and in several cases increased) during the U.S. Great Depression. O'Brien (1989) argues that the Interstate Commerce Commission's regulation

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<sup>17</sup>See McDiarmid (1947) and Brecher (1957). These tariffs had differential impacts across provinces. MacGregor (1935) outlines the practical challenges with quantifying these differential impacts, although the agreed view is that tariffs tended to boost the prices of manufacturing firms mainly located in Ontario and Quebec.

<sup>18</sup>Tariffs on fish, cattle, lumber, cheese, cream, whiskey and potatoes were also reduced.

<sup>19</sup>See Thurston (1938) for a discussion of the Toronto Transportation Commission and prices.

of prices meant that freight rates not only did not fall, but actually increased during the 1930s. Canada also had a commission which regulated freight rates, and for many of the most important routes, the rates were set to correspond to U.S. railway rates.

This evidence points to a role for government in the slow decline of nontraded prices. However, it leaves open why other nontraded prices also seemed to adjust slowly, as indicated by the small decline in the Sundries index of the COLI in Table 2.

## 2.6 Agricultural Yields in Field Crops

The agricultural sector played a large role in the Canadian interwar economy, and accounted for over 18 percent of GDP at factor cost in 1926, whereas by the mid-2000s agriculture accounted for less than 2 percent. This large role is relevant for our work for two reasons. First, as discussed above, this meant that the large swings in international prices of agricultural goods significantly impacted the real income of Canadians. Second, the large agricultural sector left the Canadian economy more exposed to adverse weather shocks than today. The Canadian prairie provinces were particularly affected by a severe drought that began in 1929 and continued, with some respites, until midsummer of 1937 (Marchildon, Kulshreshtha, Wheaton, and Sauchyn, 2008).

To examine the potential impact of adverse weather, we look at crop yields for the main field crops.<sup>20</sup> Yields are defined as total output of a specific crop (e.g., bushels of wheat) divided by cultivated acreage. To measure the impact of variations in weather conditions, we look at the yield relative to the average yield for major field crops over 1920-1940. To construct an average yield for all field crops, we use as weights the ratio of each crop's farm gross value of production to total farm gross value for field crops.<sup>21</sup>

Figure 18 plots the annual yield relative to the mean yield for our major field crops average as well as for Wheat and Oats, which were the two most important field crops, accounting for nearly eighty percent of farm gross value in 1926. There are two key points to take from the plot. First, yields during most of the 1930s were below the 1920s. Although the lowest yields coincide with the worst of the Dust Bowl during the mid to late 1930s, crop yields were also low in 1929, 1931 and 1933. In contrast, 1928 (when GDP peaks prior to the Canadian Depression) was a year of exceptionally high yields. Second, the variations in average yields were large, varying from peaks of nearly 40 percent above the average in 1928 to nearly 40 percent below in 1937. The variation in wheat yields was even larger, as variation in yields for other field crops tended to be less than that of wheat.

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<sup>20</sup>The data is from Historical Statistics of Canada Series M249-300.

<sup>21</sup>We include all field crops with at least five hundred thousand dollars worth of gross farm revenue in 1926. This includes wheat, oats, barley, mixed grains, corn, buckwheat and potatoes.

These yield variations were significant enough to impact measured GDP. In 1926, the farm gross value of wheat was roughly 442 million when GDP at factor cost was roughly 4.8 billion. In other words, the gross value of wheat was roughly nine percent of GDP. This implies that the fall in yields of roughly one third from 1926 to 1929 would correspond to a fall in GDP of nearly three percent.<sup>22</sup> In other words, variation in agricultural output due to weather was quantitatively important enough to deliver fluctuations in GDP of comparable magnitude to post-war business cycles. This leads us to use these measured real shocks in the model experiment we conduct below.

Finally, it is worth noting that while Canada was a significant agricultural exporter, it accounted for a relatively small share of world agricultural output. Even in wheat, where Canada supplied a large share of world exports, total production was roughly half that of the United States or Soviet Union. This suggests that the impact of Canadian production on global prices was likely to be relatively small. The fact that the fall in agricultural production during the 1930s coincided with a period of falling world prices supports this interpretation.

### 3 Model

The model we construct captures the most salient characteristics of the Canadian economy in the late 1920s and 30s, as outlined in Section 2. Our economic environment is a small open economy with three sectors. Sector 1's good is consumed domestically and exported abroad (X); sector 2 produces an import-competing good (M); and sector 3 produces a non-tradable good (NT). Households have identical preferences for consumption of the three sectoral goods, but may work in only one of the three sectors and cannot move across sectors.

Since we are interested in how the change in tradables prices affected the Canadian economy, we let the price of nontradables adjust to clear the domestic market while the prices of both tradable goods (X and M) evolve exogenously. Although we start from a steady-state where trade is balanced, the trade balance evolves endogenously in response to changes in traded goods prices. In addition to shocks to the price of traded goods, the model economy is exposed to real productivity shocks in the export sector sector, which capture the shocks to agricultural yields discussed in Section 2.6.

#### 3.1 Households

Households are distributed across the  $j = 3$  sectors, with  $\mu_j$  denoting the measure of households in sector  $j$ :  $\sum_{j=1}^3 \mu_j = 1$ . Households work in their respective sectors and cannot move across sectors. They may trade, with other households in their sector, a one-period, non-contingent, bond that

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<sup>22</sup>The 1926 to 1929 decline was slightly smaller since wheat acreage increased by nearly 10% and GDP also increased.

pays interest rate  $R_{jt}$ .

Households in sector  $j$  take prices as given and choose sequences of consumptions of all three goods  $\{c_{ijt}\}_{t=0}^{\infty}$  for  $i = 1, 2, 3$ , real money balances  $\left\{\frac{m_{jt}}{P_t}\right\}_{t=0}^{\infty}$ , and labor supplied  $\{l_{jt}\}_{t=0}^{\infty}$  so as to solve the following problem:

$$\begin{aligned} \max_{c_{ijt}, l_{jt}, m_{jt}} \quad & E_0 \sum_{t=0}^{\infty} \beta^t U_1 \left( CH_{jt}, l_{jt}, \frac{m_{jt}}{P_t} \right) \\ \text{s.t.} \quad & \sum_{i=1}^3 P_{it} c_{ijt} + b_{jt} + m_{jt} \leq W_{jt} l_{jt} + (1 + R_{jt}) b_{jt-1} + m_{jt-1} + x_{jt}^m + \frac{\Pi_{jt}}{\mu_j} + \Phi_{3t}, \end{aligned}$$

where  $CH_{jt} = \left( \sum_{i=1}^3 \lambda_{ci} c_{ijt}^{\rho_c} \right)^{\frac{1}{\rho_c}}$  is a consumption aggregator of all the three goods in the economy,  $l_{jt}$  is labor supplied by household type  $j$  (only to sector  $j$ ),  $m_{jt}$  are nominal money holdings,  $P_t$  is the aggregate price level,  $P_{jt}$  are sectoral price levels,  $b_{jt}$  are (non-contingent) bonds traded by type  $j$  households only (so that there is no risk-sharing across types),  $W_{jt}$  is the nominal wage rate,  $x_{jt}^m$  is a money transfer from the government and  $\Pi_{jt}$  are profits from firm ownership (households in sector  $j$  own firms in sector  $j$ ).

Finally,  $\Phi_{3t}$  is a variable that is only present in type 3 households' budget constraint. It is a wedge variable that indicates the amount of international borrowing (or lending) at which the economy can finance its trade balance. Denoting (nominal) exports by  $P_{1t}(Y_{1t} - C_{1t})$  and imports by  $P_{2t}(C_{2t} - Y_{2t})$ , where  $C_{it} = \sum_{j=1}^3 \mu_j c_{ijt}$  is domestic consumption of good  $i$  by all types of households, we are thus assuming that sector 3 households borrow internationally to finance this difference:  $\Phi_{3t} = P_{1t}(Y_{1t} - C_{1t}) - P_{2t}(C_{2t} - Y_{2t})$ . Note that while this is not a variable chosen by type 3 households, their budget constraint clears.<sup>23</sup>

### 3.2 Firms

Firms take prices and wage rates as given and produce using only labor, according to a decreasing-returns-to-scale schedule:

$$Y_{jt} = e^{z_{jt}} A_j l_{jt}^{\theta}$$

Sectoral productivities,  $A_j$ , work as a fixed capital stock and differ across sectors, partly to provide a trading motive. To model real shocks to agriculture, which accounted for a large share of

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<sup>23</sup>This is a shortcut that avoids modelling international borrow and lending while not requiring balanced trade every period (which contrasts with the data). We do not allow households in sectors 1 and 2 to borrow mainly for tractability reasons, but also because the plunge in commodity prices left many workers in commodity producing sectors with limited access to credit markets during the Depression. We plan to relax this assumption in future work.



the export sector, we allow for productivity shocks in sector X. This means that  $z_{2t} = z_{3t} = 0$  for all  $t$ , while we model the evolution of this process in sector X as an AR(1):  $z_{1t+1} = \rho_z z_{1t} + \varepsilon_{zt+1}$ , where the innovations are *iid*  $\varepsilon_{zt+1} \sim N(0, \sigma_z^2)$ .

Although firms in sectors  $j = 1, 2$  take prices  $P_{1t}, P_{2t}$  as given, since goods 1 and 2 are traded, domestic consumption need not equal domestic production at that given (world) price. In fact, our calibration guarantees that production of sector X goods exceeds domestic consumption (real exports equal  $Y_{1t} - C_{1t}$ ) and vice-versa for sector M (real imports equal  $C_{2t} - Y_{2t}$ ). In the NT sector the price level,  $P_{3t}$  adjusts so that the product market clears ( $Y_{3t} = C_{3t}$ ) for every period  $t$ .

### 3.3 Money

Money is supplied exogenously by the government through transfers to households. Its period budget constraint is  $M_t - M_{t-1} = X_t$ , where  $X_t = \sum_{j=1}^3 \mu_j x_{jt}^m$  and money market clearing yields  $M_t = \sum_{j=1}^3 \mu_j m_{jt}$ . The growth rate of the stock of money,  $g_t = \log M_t - \log M_{t-1}$  follows an exogenous AR(1) process:  $g_{t+1} = g + \rho_m g_t + \varepsilon_{mt+1}$ , where the innovations are *iid*  $\varepsilon_{mt+1} \sim N(0, \sigma_m^2)$ .

Since the stock of money is growing, nominal variables in the model are not stationary. We render them stationary by dividing by the stock of money. To that end define  $\tilde{P}_{jt} = \frac{P_{jt}}{M_t}$ ,  $\tilde{b}_{jt} = \frac{b_{jt}}{M_t}$ ,  $\tilde{P}_t = \frac{P_t}{M_t}$ ,  $\tilde{W}_{jt} = \frac{W_{jt}}{M_t}$ ,  $\tilde{x}_{jt}^m = \frac{x_{jt}^m}{M_t}$ ,  $\tilde{\Phi}_{3t} = \frac{\Phi_{3t}}{M_t}$ ,  $\tilde{\Pi}_{jt} = \frac{\Pi_{jt}}{M_t}$ , and  $\tilde{X}_t = \frac{X_t}{M_t}$ .

Prices in the traded sectors ( $j = 1, 2$ ) also evolve exogenously. We start by rendering prices stationary by dividing them by the money supply:  $\tilde{P}_{jt} = \frac{P_{jt}}{M_t}$ . We then assume that the stationary price level's law of motion is given by an AR(1):  $\tilde{P}_{jt+1} = p_j + \rho_{p_j} \tilde{P}_{jt} + \varepsilon_{p_{jt+1}}$ , where the innovations are *iid*  $\varepsilon_{p_{jt+1}} \sim N(0, \sigma_{p_j}^2)$ .

Given  $g_0, M_0$ , and the laws of motion for the stock of money and prices in the traded sectors, an equilibrium is quantities  $\left\{ \tilde{b}_{jt}, c_{jt}, c_{ijt}, C_{jt}, Y_{jt}, l_{jt}, \tilde{X}_t, \tilde{x}_{jt}^m, \tilde{\Phi}_{3t}, \tilde{\Pi}_{jt} \right\}_{t=0}^{\infty}$ , for  $i = 1, 2, 3$  and  $j=1, 2, 3$  and prices  $\left\{ \tilde{P}_{3t}, \tilde{P}_t, R_{jt}, \tilde{W}_{jt}, \tilde{x}_{jt} \right\}_{t=0}^{\infty}$ , for  $j = 1, 2, 3$ , such that all households and firms in each sector solve the problems described above subject to market clearing conditions. The households' and firms' first-order conditions, together with the wage setting equations and the market clearing conditions for the sectoral goods and for the labor market in the export sector constitute the set of necessary conditions for an equilibrium.

### 3.4 Parameterization

We parameterize the model economy to match key moments of the Canadian economy in 1926, prior to the decline in the prices of tradable goods. We set the model period to equal one year, since most of the available macro data for Canada is annual.

Our data counterpart of the export sector is the sum of Agriculture, Forests and Fishing, Mining,

and three manufacturing industries: Food, Wood, and Pulp and Paper. The importin-competing sector is the remainder of Manufacturing, while the nontraded sector is the rest of the economy. This repartition implies that in steady-state, the export sector ( $X$ ) accounts for 33 percent of GDP, while the import competing sector ( $M$ ) accounts for 12 percent. In terms of employment, sector  $X$  accounts for 45 percent while sector  $M$  is responsible for 12 percent. We also constrain the model parameters such that the value-added share of imports (and exports, given our balanced-trade assumption) is 29 percent in steady-state. This gives us five moments to target.

The momentary utility form is additive in consumption, labor and real money balances:

$$U_1 \left( CH_{1t}, l_{1t}, \frac{m_{1t}}{P_t} \right) = \frac{CH_{1t}^{1-\sigma}}{1-\sigma} - \frac{l_{1t}^{1-\sigma_L}}{1-\sigma_L} + \lambda_M \frac{\left( \frac{m_{1t}}{P_t} \right)^{1-\sigma_M}}{1-\sigma_M}$$

We make the following normalizations:  $\sum_{i=1}^3 \lambda_{c_i} = 1$  and  $A_3 = 1$ . We let preferences be logarithmic in aggregate consumption ( $\sigma = 1$ ). We set the elasticity of substitution between the different consumption goods to two-thirds ( $\rho_c = -0.5$ ) and the Frisch elasticity to one-half ( $\sigma_L = -2$ ), values that are common in the literature. We also opt for log preferences in real money balances ( $\sigma_m = 1$ ) so as to have a unit elasticity with respect to consumption. We perform sensitivity analysis with respect to the utility curvature parameters below.

We estimate an AR(1) process for the growth rate of money on yearly M1 data from 1921 to 1971. This yields  $g = 0.0161$ ,  $\rho_m = 0.6509$  and  $\sigma_g = 0.05$ . This implies a steady-state money growth rate of  $\bar{g}_m = \frac{g}{1-\rho} = 0.0461$ . Given a model period of one year, targeting a nominal interest rate of 5.6 percent implies  $\beta = \frac{1+\bar{g}_m}{1+R} \simeq 0.99$ .<sup>24</sup> All parameter values are summarized in Table 3.

### 3.5 Shocks

Our benchmark experiment consists of feeding in two sets of shocks: (1) a sequence of estimated price shock innovations  $\{\hat{\varepsilon}_{p_{1t}}, \hat{\varepsilon}_{p_{2t}}\}_{t=1926}^{1939}$  constructed to match the path of tradables' prices  $\{P_{1t}, P_{2t}\}_{t=1926}^{1939}$ ; and (2) a sequence of estimated real productivity shock innovations to sector  $X$ ,  $\{\hat{\varepsilon}_{zt}\}_{t=1926}^{1939}$ .

We use the GNE deflator series for exports and imports as the data targets for our prices (see Figure 5). We stationarize the price series  $\{P_{1t}, P_{2t}\}_{t=1926}^{1939}$  by dividing by their 1926-70 growth rate. We then estimate AR(1) processes for both series. We obtain  $\hat{\rho}_{p_1} = 0.9676$ ,  $\hat{\rho}_{p_2} = 0.9586$ . Using this, we back out the residuals,  $\{\hat{\varepsilon}_{p_{1t}}, \hat{\varepsilon}_{p_{2t}}\}_{t=1926}^{1939}$ , that yield the observed price paths in the model and in the data.

<sup>24</sup>The nominal interest rate on long-term dominion bonds averaged 5.6 percent in the 1920s. We could not find data on shorter maturity government bonds.

To obtain a series of real shocks in sector X,  $\{z_{1t}\}_{t=1926}^{1939}$ , we use the data on real yields described in Section 2.6 (see Figure 18). We estimate an AR(1) on the stationarized average yields series and then rescale the variance of the shocks to reflect the fact that agriculture was roughly 55 percent of the X sector in value added terms and that field crops represented about two-thirds of agricultural gross revenues in 1926. From this estimation we obtain  $\rho_z = 0.52$  and  $\sigma_z = 0.07$ .

## 4 Results

Our counterfactual experiments quantify the contribution of shocks to traded goods prices and variations in agricultural yields to the fall in output during the Canadian Great Depression. We first examine these shocks using a version of the model without nominal frictions. We find that the fall in the price of tradables over 1928 to 1933 has little impact on output as the nontradable price falls nearly as much. As a result, the model does not generate the rise in the price of nontraded goods relative to traded goods observed in the data.

This leads us to introduce nominal frictions to generate a shift in relative prices in response to the fall in traded goods prices. Since the contraction period was characterized by increases in real wages in sectors M and NT, as shown in Figure 11, we opt for modeling nominal wage frictions by assuming that in these two sectors, nominal wages are determined by Taylor-type wage contracts.<sup>25</sup>

The fall in tradables prices interacts with these frictions along two key margins. First, the increase in sector M's real product wage results in a substantial fall in production. This fall is even larger than in a closed economy model, since households can import relatively cheap sector M goods. In the NT sector prices cannot go down as much as in the frictionless environment because this implies an increase in real wages, given the nominal wage sluggishness. As a result, the relative price of nontradables to tradables goes up just like in the data, and the production in the NT sector is reduced. When we add to this the impact of the real shocks to the exporting sector, we obtain a fall in aggregate output that is over half of what we see in the data.

### 4.1 No Nominal Frictions

In Amaral and MacGee (2002), we found that terms of trade shocks in a frictionless small open economy (as in Backus, Kehoe, and Kydland (1995)) calibrated to the interwar Canadian economy imply a small decline in aggregate output. We find a similar result here in our nominal multi-sector, frictionless, environment when we feed in the computed price shocks.<sup>26</sup>

<sup>25</sup>Figure 11 shows industry nominal wages deflated by the sectoral price. Thus, while Manufacturing is deflated by the import price, the service wages are deflated by our computed nontraded price.

<sup>26</sup>We focus on the price shocks only here since this motivates the extension of the model to include nominal rigidities. Including the real shocks to sector X in the frictionless version of our model economy does not change the

The impact of the fall in the prices of traded goods on real output is small, peaking at 3 percent (see Figure 13). This is mainly due to the fall in nontraded price and wages that nearly parallel the fall in tradable prices and wages. As a result, real product wages remain nearly constant in all three sectors. Since real wages fail to move significantly, neither does labor, or output.

This downward adjustment of nominal wages to the fall in prices corresponds to what is observed in the data for agriculture and logging (see Figure 7). However, it contrasts with what happened in manufacturing or in some of the services (see Figure 8). There, real wages increased, sometimes substantially, as Figure 11 shows. This leads us to introduce staggered wage contracts in our model economy in the following section.

## 4.2 Nominal wage frictions

We extend our model and assume that wages in sectors 2 and 3 adjust slowly due to nominal rigidities and that hours are determined by the short side of the market in these sectors. This means that firms optimally set hours according to their marginal product of labor schedule in sectors M and NT. While the firms do not have to necessarily be the short side of the market, in this case, because of the high real wages, the hours the households want to supply will turn out to be higher than those that firms wish to employ given the path of prices.<sup>27</sup> In sector 1, the wage rate adjusts to clear the market (i.e., labour demand is equated to labour supplied).

In the M and NT sectors, wages are subject to Taylor-type contracts. Labor is divided into two equally-sized cohorts and each period, the contract wage of one of the cohorts is adjusted. The nominal wage the firm pays is a geometric average of the two cohorts' contract wages:

$$W_{jt} = x_{jt}^{0.5} x_{jt-1}^{0.5}, \quad j = 2, 3. \quad (1)$$

The contract wage in period  $t$ ,  $x_{jt}$ , depends on the current and future expected nominal wages and labor gaps relative to steady-state, so that:

$$\log x_{jt} = 0.5 \log W_{jt} + \gamma_j (L_{jt} - \bar{L}_j) + E_t \left\{ 0.5 \log W_{jt+1} + \gamma (L_{jt+1} - \bar{L}_j) \right\} \quad j = 2, 3. \quad (2)$$

where  $\gamma_j$  is a labor-gap adjustment parameter.

Repeated substitution of (1) into (2) yields the current contract wage as a function of past and

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message that the model is unable to generate the shift in the relative price of traded to nontraded goods observed in the data.

<sup>27</sup>We verify ex-post that indeed, the hours that come out of the households' FOC given the wage rate are higher than those that come out of the firms' FOC in sectors 2 and 3 for all the periods in our experiment.

expected contract wages and the current and expected labor gaps:

$$\log x_{jt} = \frac{1}{2} \log x_{jt-1} + 2\gamma_j (L_{jt} - \bar{L}_j) + E_t \left\{ \frac{1}{2} \log x_{jt+1} + 2\gamma_j (L_{jt+1} - \bar{L}_j) \right\}.$$

A crucial parameter is  $\gamma_j$ , which controls the degree of nominal wage adjustment, as per equation 2. To discipline this parameter, we pick values for  $\gamma_j$  such that the sectoral real product wages the model generates increase as much as in the data up until 1933. Figure 11 shows real wages for selected industries (deflated by the respective sectoral price). The manufacturing real wage had increased roughly 30 percent by 1933, so we set  $\gamma_2$  so that the real wage in the import-competing sector in the model increases by 30 percent also. The increase in real wages for services was lower, as the real wages for Construction, Telephone and Rail in the same figure illustrate. Accordingly, we (conservatively) set  $\gamma_3$  so that the real wage in the model's NT sector increases by 6 percent.

In our benchmark experiment we input the price shocks and the real shocks to sector X. As panel A in Figure 15 shows, the combination of price shocks, TFP shocks, and nominal frictions implies a decline in real output of 17 percent at the trough: over half of the fall seen in the data. In sector X, the fall in model output is about a third of that in the data and it is entirely driven by the real agricultural shocks, since X-sector hours are constant (panel B of Figure 17). This is due to our log specification in the consumption aggregate, which implies the income effect and the substitution effect from a change in the real wage cancel out. This does not happen for the two other sectors since the firm side determines hours there.

In the nontraded sector, the fall in output is over half that in the data, as seen in panel D of Figure 15. While the model overstates the fall in output in the import-competing sector (panel C), this overprediction does not drive the fall in aggregate output since the share of sector M in GNP is only 12 percent. It is instead because the nominal wage friction is preventing the NT price from adjusting down in line with the tradables prices.

While, by construction, we match the fall in prices in the two tradable sectors, as panels B and C of Figure 16 show, the model does a good job of keeping the NT price from falling too much (panel D). Consequently it matches the aggregate price quite well (panel A). Absent the nominal frictions in sector NT, prices in this sector would fall roughly in line with tradables prices. A smaller nominal wage friction in sector NT would allow the NT price to adjust downward toward the data, but the increase in the real product wage rate would then be smaller, and less in line with the data, also implying less downward action in NT (and aggregate) output.

The fact that the model generates no fall in hours in sector X implies that on aggregate, the fall in hours is smaller than in the data, as panel A in Figure 17 shows, despite the fact that hours

in sector M fall much more than in the data (panel C).<sup>28</sup> Nonetheless, the model does a good job of matching the fraction of the output fall that changes in total hours are responsible for. Measuring aggregate total factor productivity (TFP) simply by  $\frac{Y_t}{L_t^\theta}$ , Figure 19 shows that the model captures half of the fall in TFP from 1926 to 1933 but misses the run-up to 1929. Most of this initial increase in measured TFP is coming from sector M, where we do not model real shocks. Sector M’s output per capita increased by roughly 30 percent from 1926 to 1929, while hours only increased by 10 percent.

Regarding foreign trade, we are assuming the economy starts out from balanced-trade where exports and imports both account for 29 percent of GDP. From there, both nominal imports and exports fall: by 10 percent and 44 percent at the trough, respectively. Together with the fall in GDP this implies a trade deficit at the trough of roughly 13 percent of GDP, somewhat larger than the fall we see in the data, as Figure 20 shows.

Real consumption decreases the most for households in sector M, even as their real consumption wage goes up by 12 percent. This is because their real compensation goes down by roughly 50 percent, as their labor plummets, as shown in panel C of Figure 17. The fact that they continue to supply the same amount of labor does not prevent consumption for households in sector X from declining roughly 25 percent, as their nominal wage falls by 35 percent, roughly in line with the fall in the price of exports. Finally, households in the NT sector actually experience a purchasing power increase.<sup>29</sup>

### The relative role of individual shocks

To assess the relative importance of the two kinds of exogenous shocks in our model we run two experiments where we subject our model economy to one set of shocks at the time. Figure 21 indicates that the price shocks play the more prominent role, but real technological shocks are instrumental in generating a hump in the early years, as well as in delivering the trough in 1933 as opposed to 1932, which is what happens when only price shocks operate.

### The relative role of individual frictions

The main driver of the fall in output are the nominal wage frictions in sectors M and NT. To better understand their individual role, we run two experiments where we turn off these frictions one at a time and let the wage in the respective sector move such as to clear the labor market at

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<sup>28</sup>Again, recall that because of sector M’s small size, the quantitative impact of this overprediction is small.

<sup>29</sup>This increase happens because sector NT households are allowed to borrow internationally to finance the trade deficit, while not internalizing the cost of those loans, as detailed in section 3.1. Were sector 3 households to decide optimally on the amount they borrow internationally, we conjecture their consumption would be lower and the fall in aggregate output would be even larger.

the hours supplied by the households and demanded by firms. In each experiment, we continue to match the path of prices in sectors X and M, and we recalibrate the nominal frictions in each sector,  $\gamma_i$ , such as to continue to match the increase in the respective real product wage. As Figure 22 shows, both nominal frictions are quantitatively important. Note that when only the NT sector is subject to nominal wage frictions, labor in sector M does not move (and consequently neither does output in this sector) so all the fall in aggregate output is coming from the decline in NT sector's output. In contrast, when only the M sector is subject to nominal wage frictions, the price in sector NT declines substantially more than in the data – roughly 25 percent. We take these results to mean that modeling nominal frictions in both sectors is crucial to obtaining meaningful magnitudes in terms of the aggregate output decline.

### Sensitivity analysis

We perform sensitivity analysis with respect to the parameters governing curvature in utility. Panel A of Figure 24 shows how the path of aggregate output varies when we vary the intertemporal elasticity of substitution in aggregate consumption from the benchmark log preferences ( $\sigma = 1$ ) to  $\sigma = 0.75$  and  $\sigma = 1.25$ . In panel B, we vary the curvature parameter on real money balances from the benchmark ( $\sigma_M = 1$ ) to  $\sigma_M = 1.25$  and  $\sigma_M = 0.75$ . In panel C, we vary the degree of elasticity between the components of the aggregate consumption bundle from the benchmark ( $\rho_c = -0.5$ ) to  $\rho_c = -0.75$  and  $\rho_c = -0.25$ . Finally, in panel D, we vary the parameter controlling the Frisch elasticity from the benchmark ( $\sigma_L = -2$ ) to  $\sigma_L = -2.5$  and  $\sigma_L = -1.5$ . As the figure shows, the magnitude of the fall is impervious to small changes in each of these parameters.

### 4.3 Adding contractionary monetary shocks

So far, we have been assuming that the money supply grows at a constant rate throughout the period we analyse. This is not accurate. From 1929 to 1933, M1 decreased by 25 percent. Importantly, there is a literature arguing that contractionary monetary shocks combined with nominal wage frictions can account for most of the output decline in the U.S. Great Contraction.<sup>30</sup> Therefore, to the extent that these contractionary monetary shocks matter for the determination of prices in the NT sector, our simulation may be missing an important source of volatility.

To examine this possibility, we feed in a sequence of estimated shocks  $\{\hat{\varepsilon}_{mt}, \hat{\varepsilon}_{p1}^m, \hat{\varepsilon}_{p2}^m, \hat{\varepsilon}_{zt}\}_{t=1926}^{1939}$ . From the growth rate of money estimation above we obtain estimated growth rate of money innovations  $\hat{\varepsilon}_{mt}$ . Next, we proceed as before, stationarizing the price series and then backing out the residuals,  $\{\hat{\varepsilon}_{p1t}^m, \hat{\varepsilon}_{p2t}^m\}_{t=1926}^{1939}$ , that yield the same price paths in the model and in the data. Note that in this experiment the price paths for the X and M sectors are the same as in our benchmark

<sup>30</sup>See Bordo, Erceg, and Evans (2000).

(and in the data). It is the estimated price innovations that are different. Again, we re-estimate the parameters regulating the degree of nominal wage frictions,  $\gamma_i$ , so as to continue to hit the same targets as before. As Figure 23 shows, modeling contractionary monetary shocks adds little to the model's ability to match the fall in output.

Nonetheless, one should not be quick to dismiss deflationary shocks as an important factor in the downturn just because of this result. Unlike what happened in the United States, where the monetary base was controlled by the Federal Reserve, in Canada this was not the case, which implies that making inference about the importance of deflationary shocks by modeling changes in M1's growth rate as an exogenous process may not be warranted. Note, in particular that the model endogenously delivers a very realistic deflation simply through the combination of the Canadian's economy exposure to the collapse in tradable prices and the presence of domestic nominal wage frictions.

## 5 Conclusion

We argue that changes in relative prices are important in accounting for the decline in Canadian output in the Great Depression. The price of tradables fell substantially, relative to that of non-tradables, in Canada after 1926. Price shocks designed to mimic these price changes, together with real shocks to the export sector, that are intended to stand in for weather shocks the (large) Canadian agricultural sector suffered through the Dust Bowl years, interact with wage rigidities in the import-competing and nontraded sectors of our multi-sector model economy to generate a fall in real output that is over half the one seen in the data.

The large fall in the relative price of tradables to non-tradables during the Great Depression had hitherto been a fact that, while not entirely ignored, did not merit much consideration as a possible factor behind the large output collapses. Our research points to this being a serious possibility, especially for small open economies that largely relied on commodity exports at the time, like Canada, but also like Australia and Argentina. Moreover, while surely smaller in relative scale, it would be interesting to see what the implications are for the U.S. economy.

Although our model economy captures key features of the interwar Canadian economy, it abstracts from some potentially important features such as capital accumulation and international borrowing and lending. We plan to explore these mechanisms in future work.



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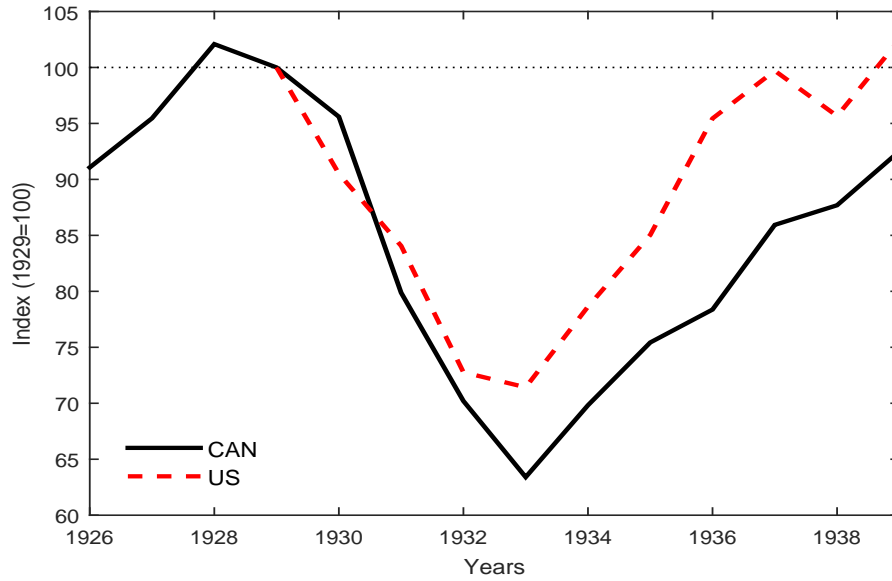
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Table 3: **Parametrization**

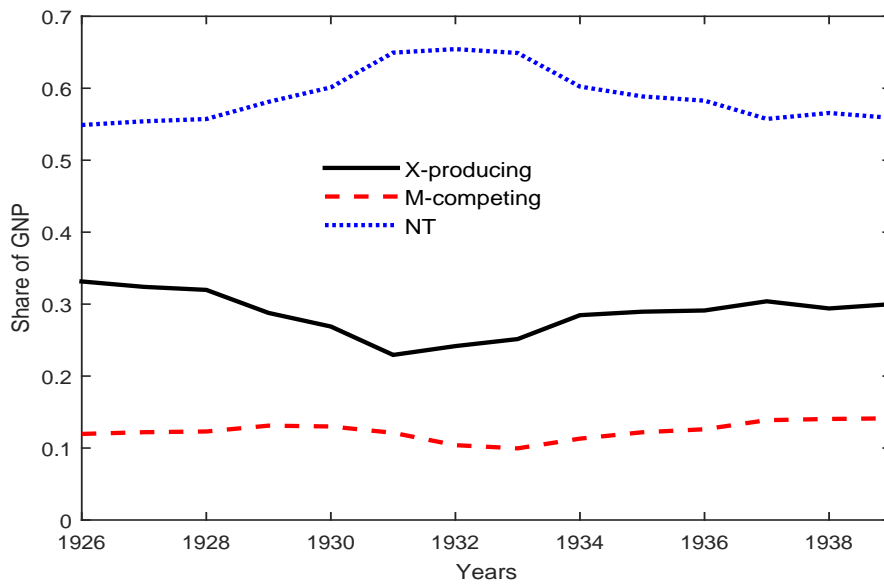
Parameter	Value	Target
$\beta$	0.99	Annual nominal interest rate 5.6%
$\gamma_2$	0.004	Match increase in M real wage
$\gamma_3$	0.001	Match increase in NT real wage
$\mu_1$	0.45	Employment in sector X: 45%
$\mu_2$	0.12	Employment in sector M: 12%
$\lambda_{c1}$	0.013	GDP share of sector X: 33%
$\lambda_{c2}$	0.454	GDP share of sector M: 12%
$\lambda_M$	0.015	<a href="#">Bordo, Erceg, and Evans (2000)</a>
$\sigma$	1	log-specification
$\sigma_M$	1	Unit elasticity w.r.t consumption
$\rho_c$	-0.5	Elasticity of substitution between goods of 2/3
$\sigma_l$	-2	Frisch elasticity of 1/2
$\rho_{p1}$	0.968	Estimation of AR(1) process from X-price data
$\rho_{p2}$	0.959	Estimation of AR(1) process from M-price data
$A_1$	0.8	Export share of GDP: 29%
$A_2$	0.8	Normalization
$A_3$	1	Normalization
$\theta_1$	0.7	Labor income share in sector X of 70%
$\theta_2$	0.7	Labor income share in sector M of 70%
$\theta_3$	0.7	Labor income share in sector NT of 70%
$g$	0.016	Estimation of AR(1) process from M1 data
$\rho_m$	0.651	Estimation of AR(1) process from M1 data
$\rho_z$	0.52	Estimation of AR(1) process from crop yields
$\sigma_g$	0.05	Estimation of AR(1) process from M1 data
$\sigma_z$	0.07	Estimation of AR(1) process from crop yields

Figure 1: Real GDP Per Capita, Canada and United States



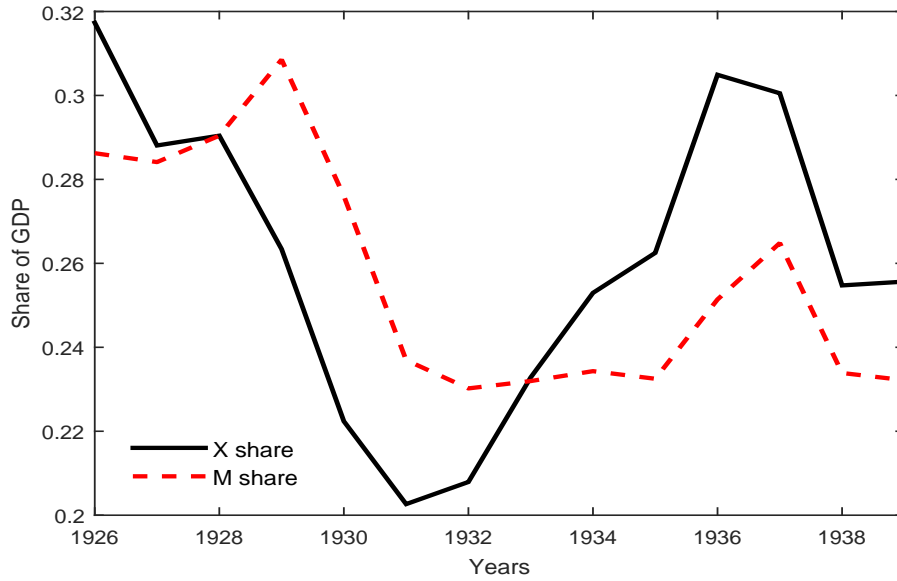
Sources: Bureau of Economic Analysis and Historical Statistics of Canada

Figure 2: Sectoral Shares of (Nominal) GNP



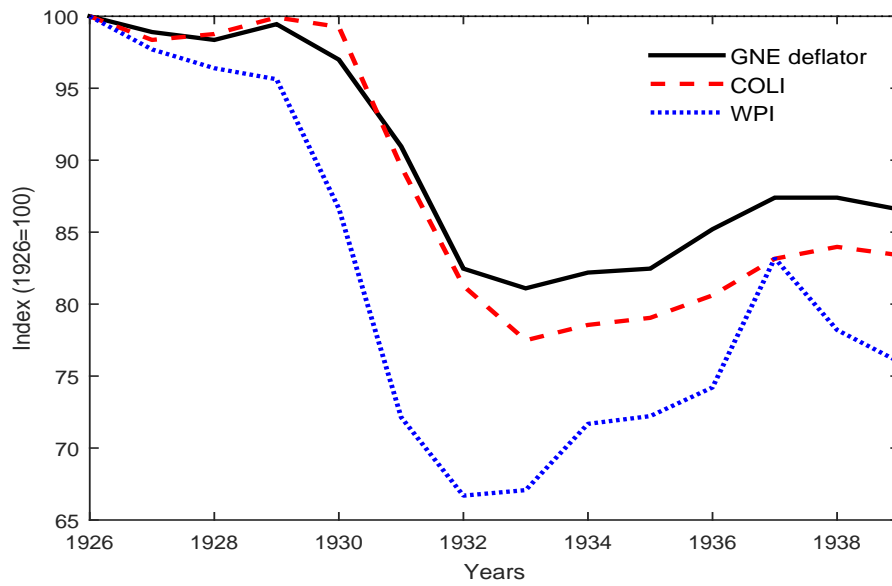
Sources: Historical Statistics of Canada

Figure 3: Trade Shares



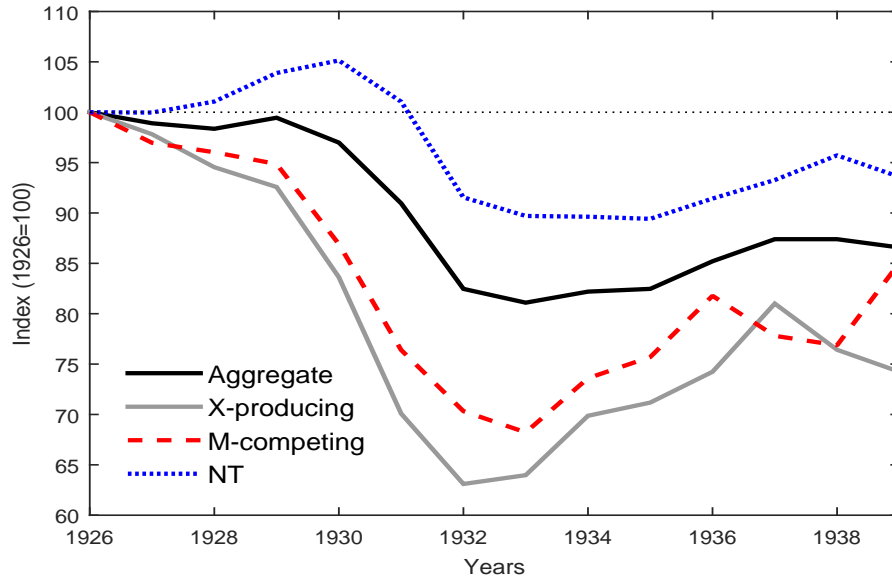
Sources: Historical Statistics of Canada

Figure 4: Canadian Aggregate Price Indices



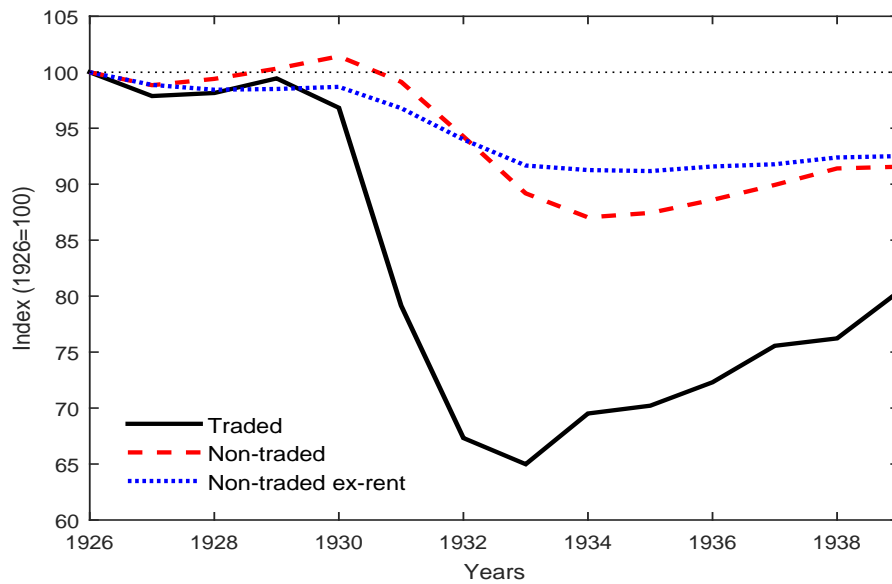
Sources: Historical Statistics of Canada and Dominion Bureau of Statistics

Figure 5: Prices: Exports, Imports and Nontradables



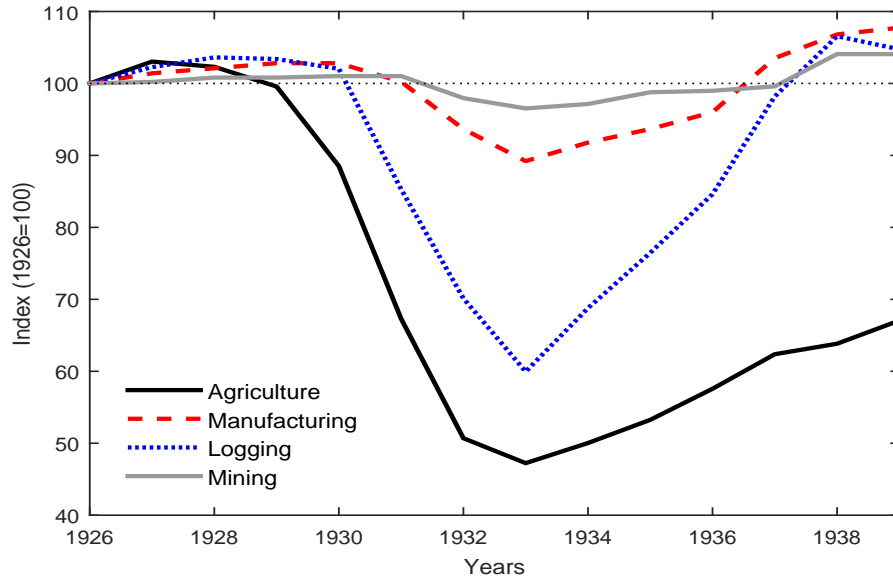
Sources: Historical Statistics of Canada and authors' calculations

Figure 6: Canada: Traded vs Nontraded Prices



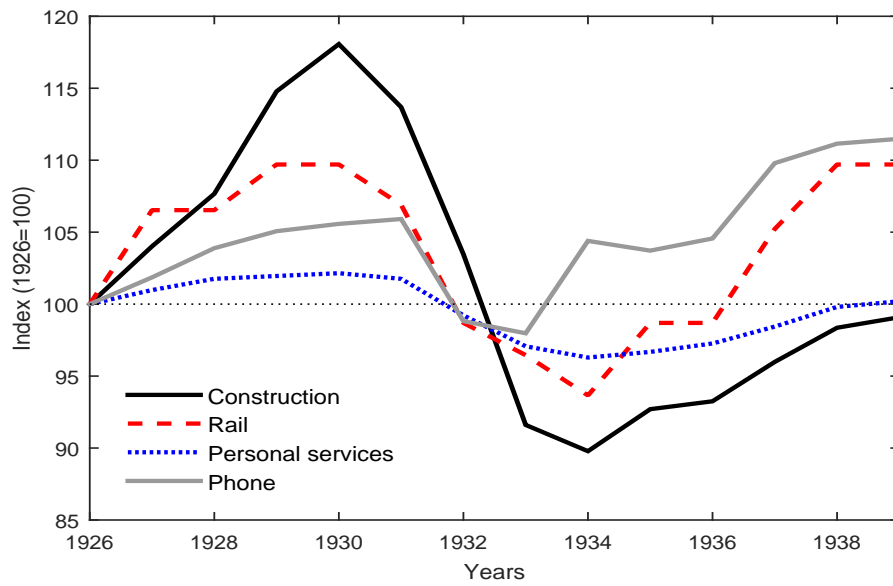
Sources: Historical Statistics of Canada and Dominion Bureau of Statistics

Figure 7: Canada: Nominal Wages Traded



Sources: Dominion Bureau of Statistics

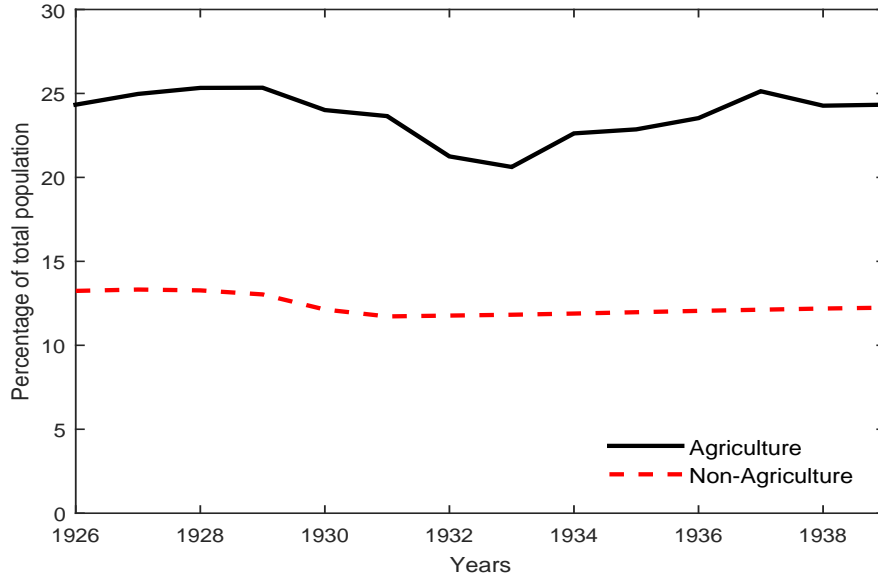
Figure 8: Canada: Nominal Wages Nontraded



Sources: Dominion Bureau of Statistics

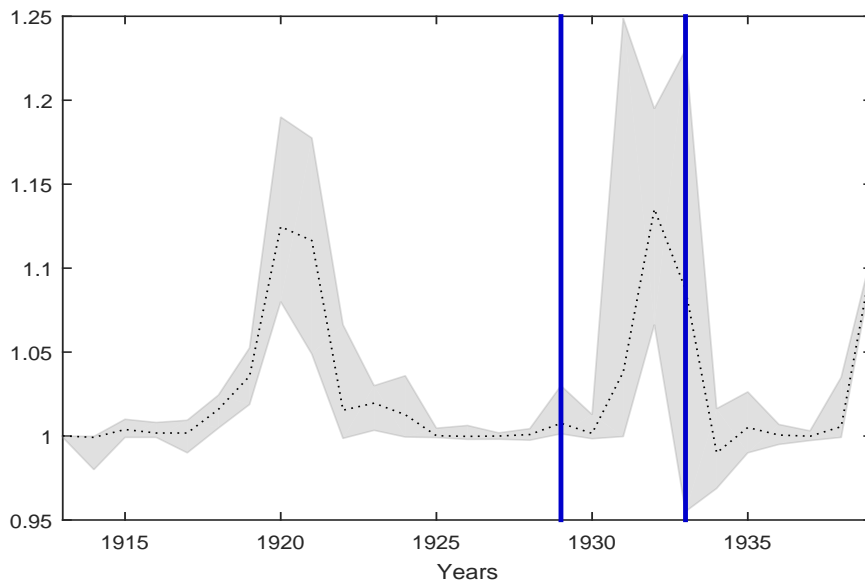


Figure 9: Employment



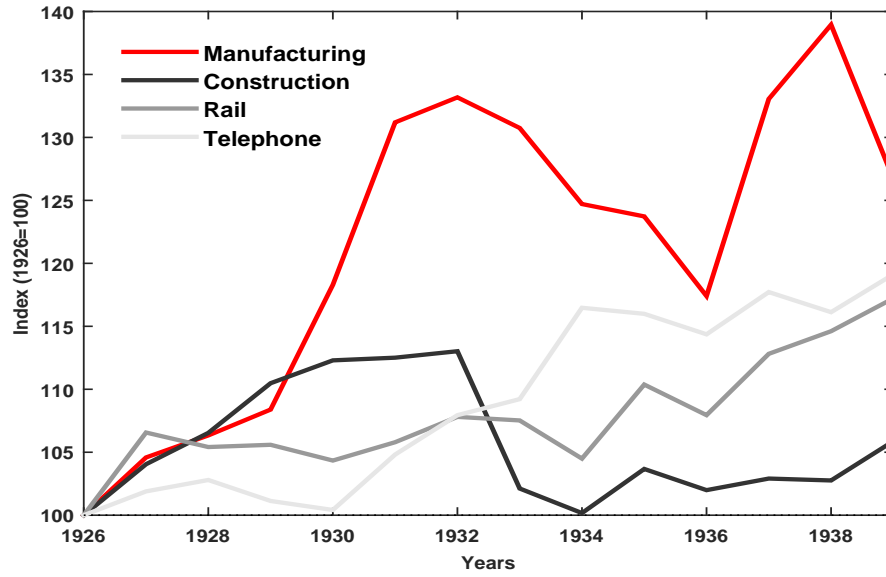
Sources: Historical Statistics of Canada

Figure 10: Exchange rate: Can\$ per US\$



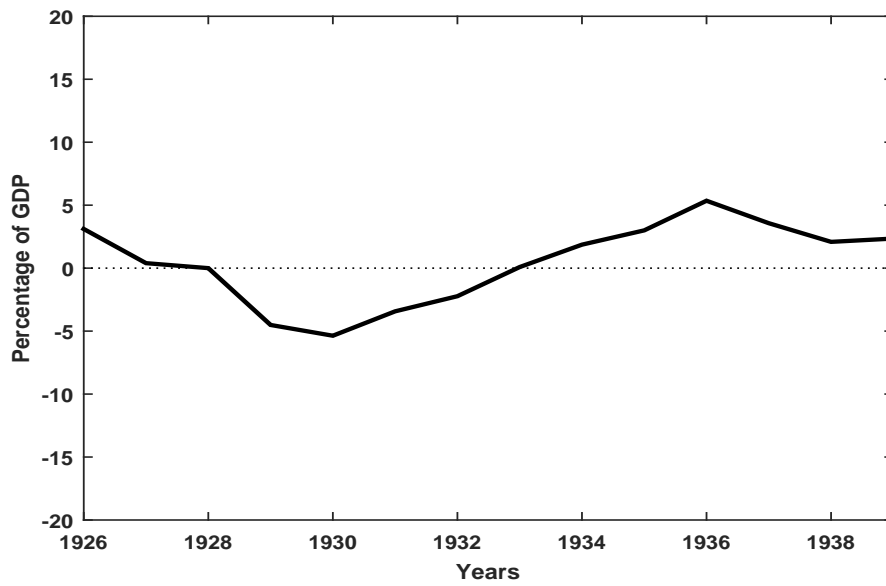
Sources: Historical Statistics of Canada

Figure 11: Real product wages: selected industries



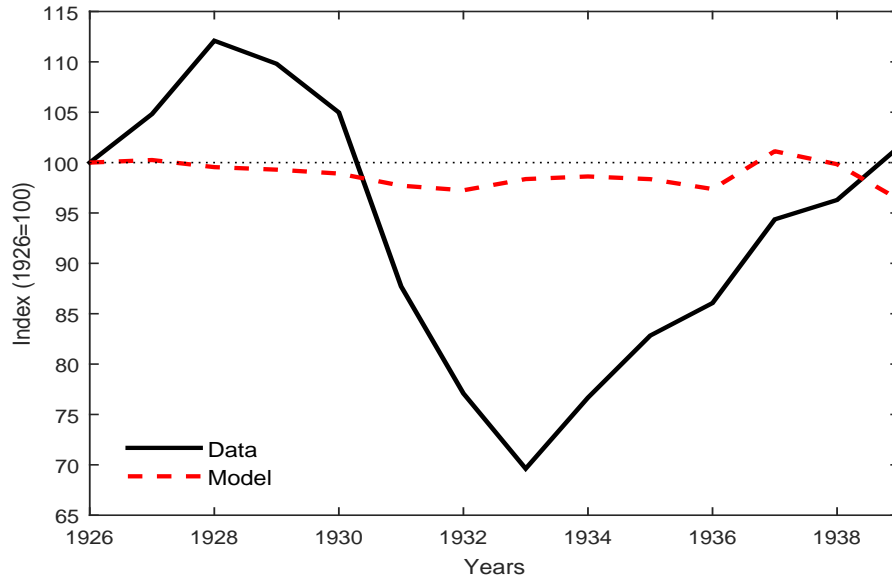
Sources: Dominion Bureau of Statistics and authors' calculations

Figure 12: Trade balance



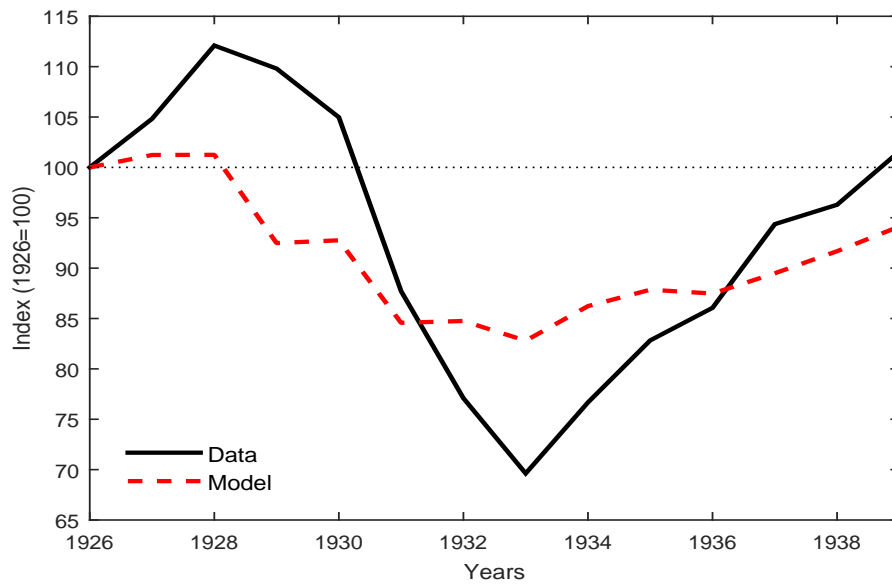
Sources: Historical Statistics of Canada

Figure 13: Real output: frictionless model



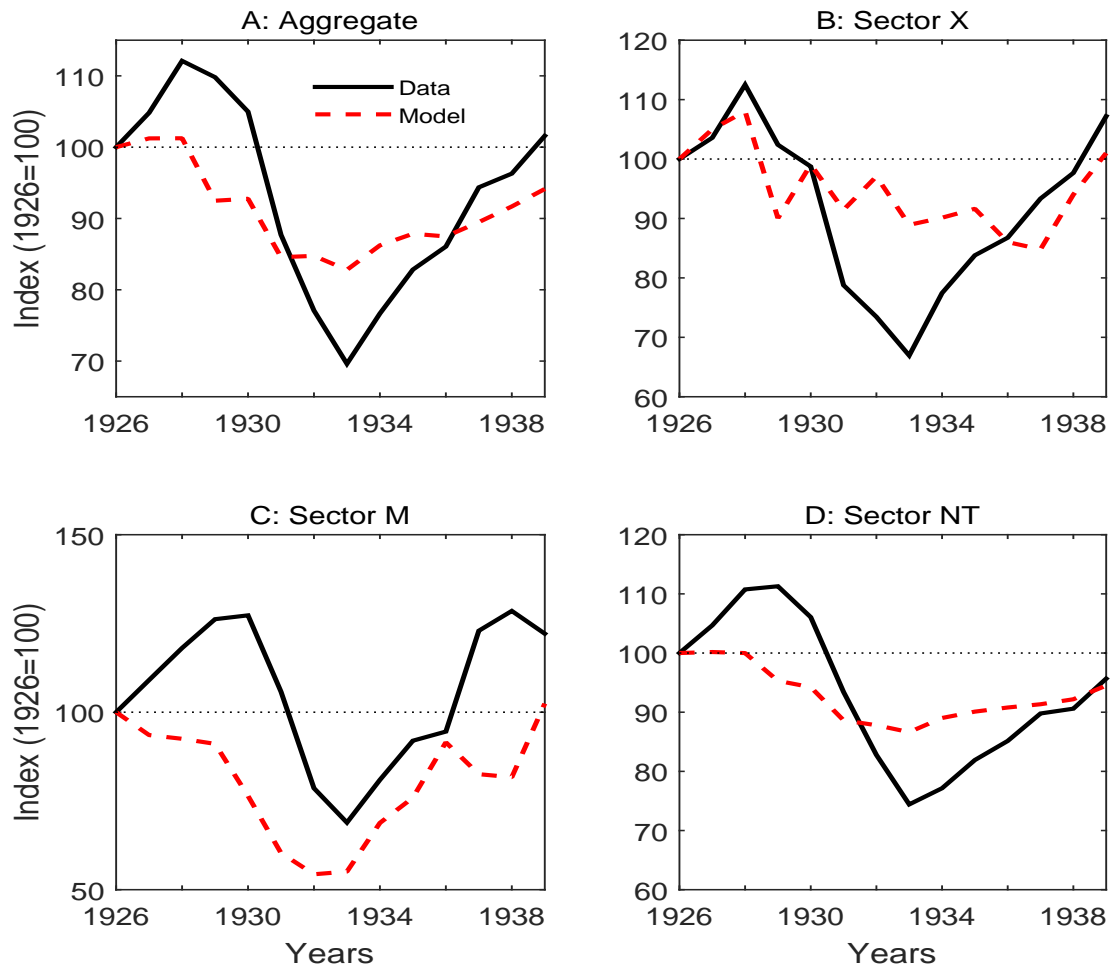
Sources: Historical Statistics of Canada and authors' calculations

Figure 14: Real output: nominal wage frictions



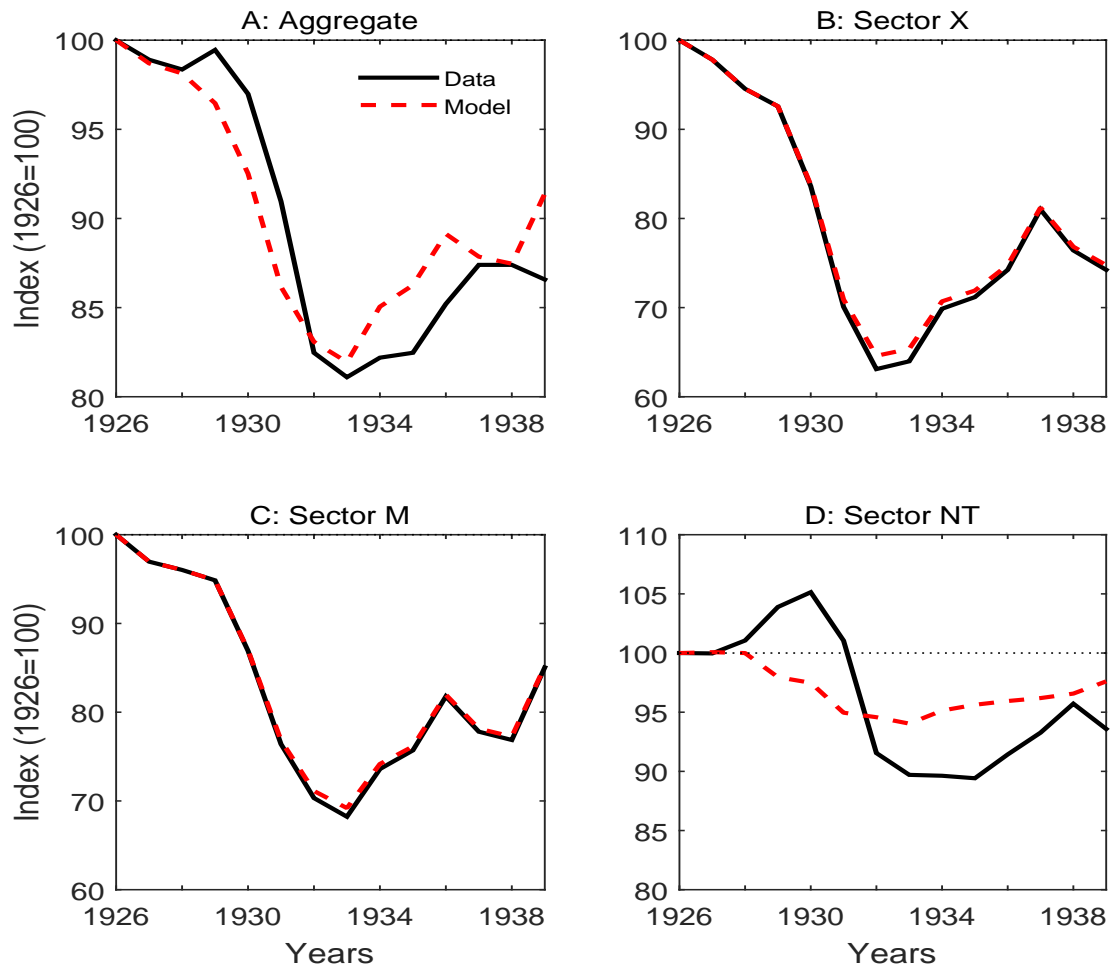
Sources: Historical Statistics of Canada and authors' calculations

Figure 15: Real output



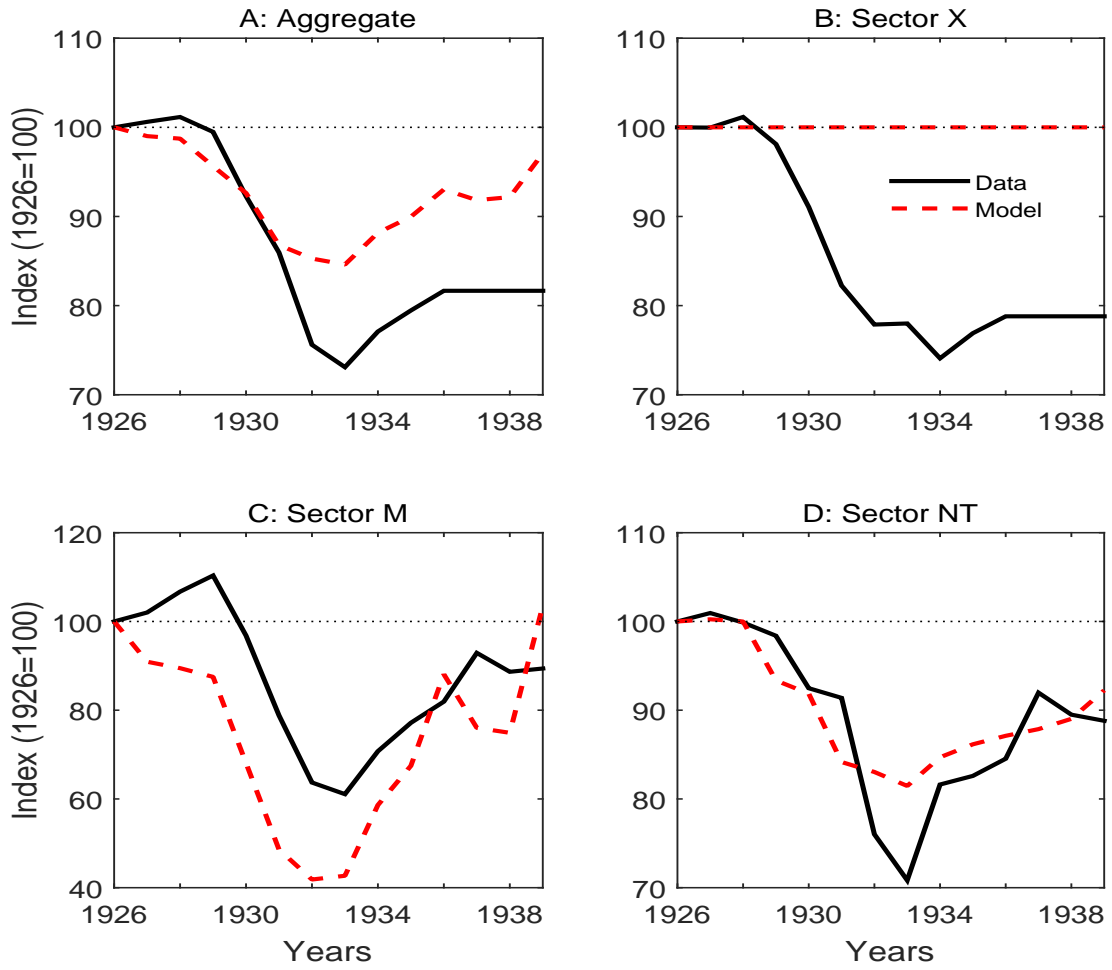
Sources: Historical Statistics of Canada and authors' calculations

Figure 16: Prices



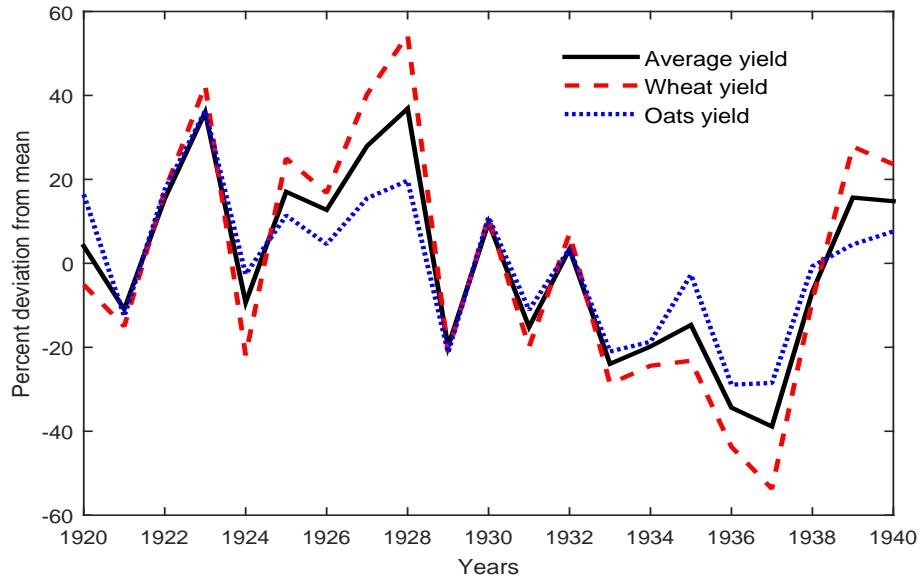
Sources: Historical Statistics of Canada and authors' calculations

Figure 17: Labor



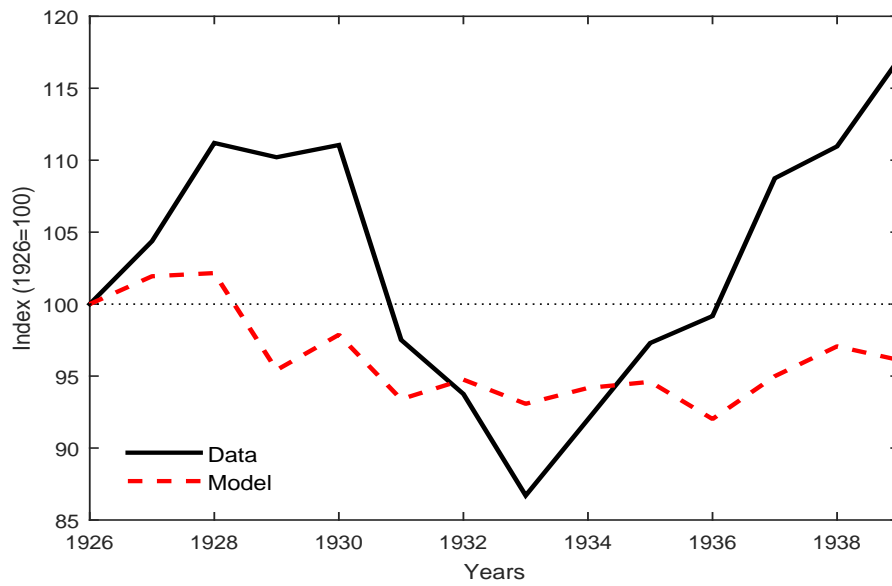
Sources: Historical Statistics of Canada and authors' calculations

Figure 18: Selected crop yields



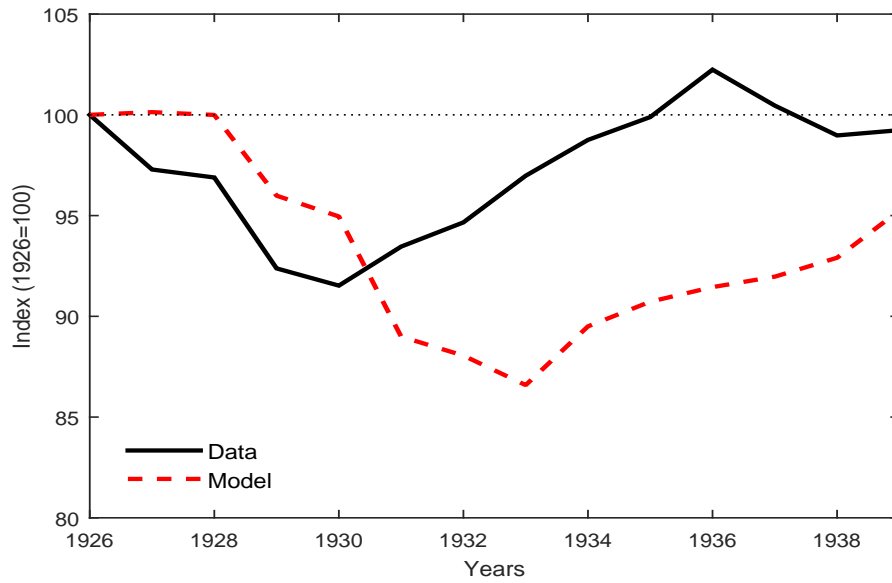
Sources: Historical Statistics of Canada and authors' calculations

Figure 19: Measured TFP



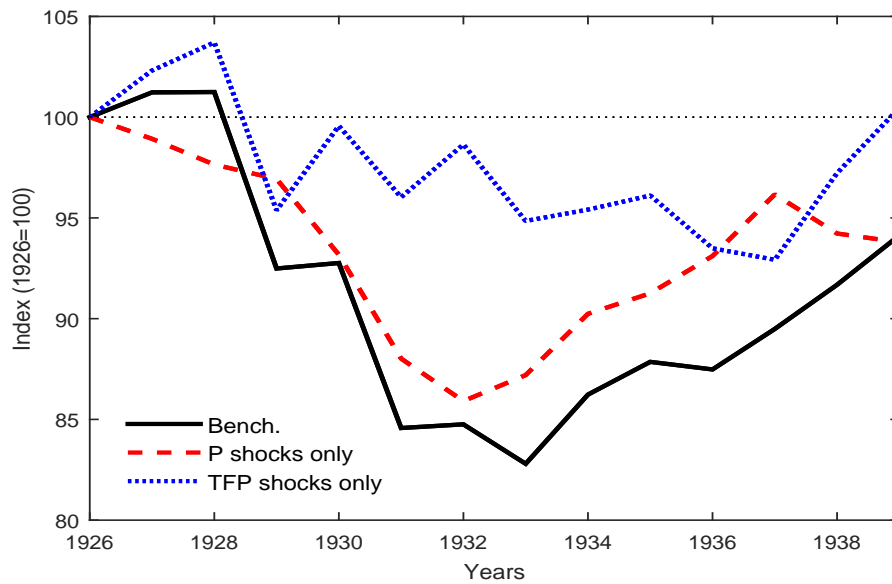
Sources: Historical Statistics of Canada and authors' calculations

Figure 20: Trade balance as % of GDP



Sources: Historical Statistics of Canada and authors' calculations

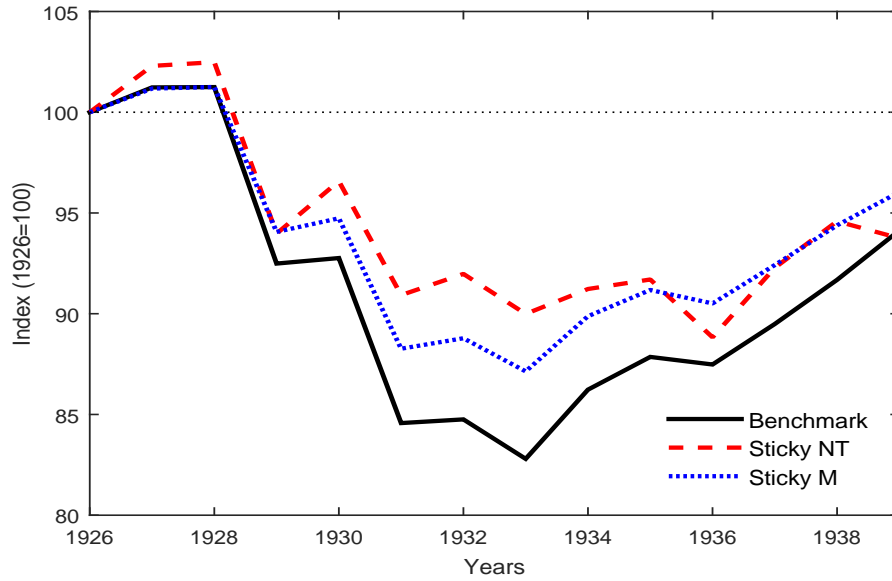
Figure 21: Output: individual shocks



Sources: Authors' calculations

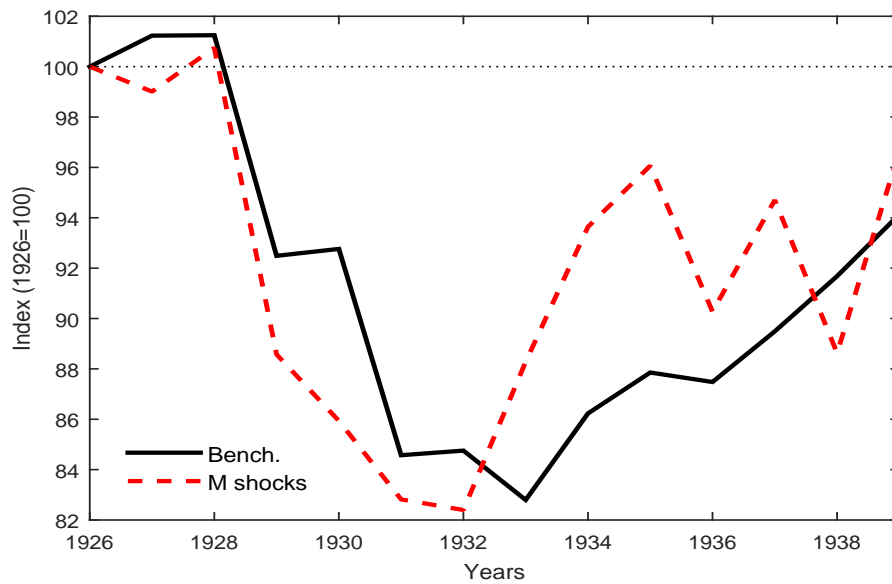


Figure 22: Output: only one sticky-wage sector



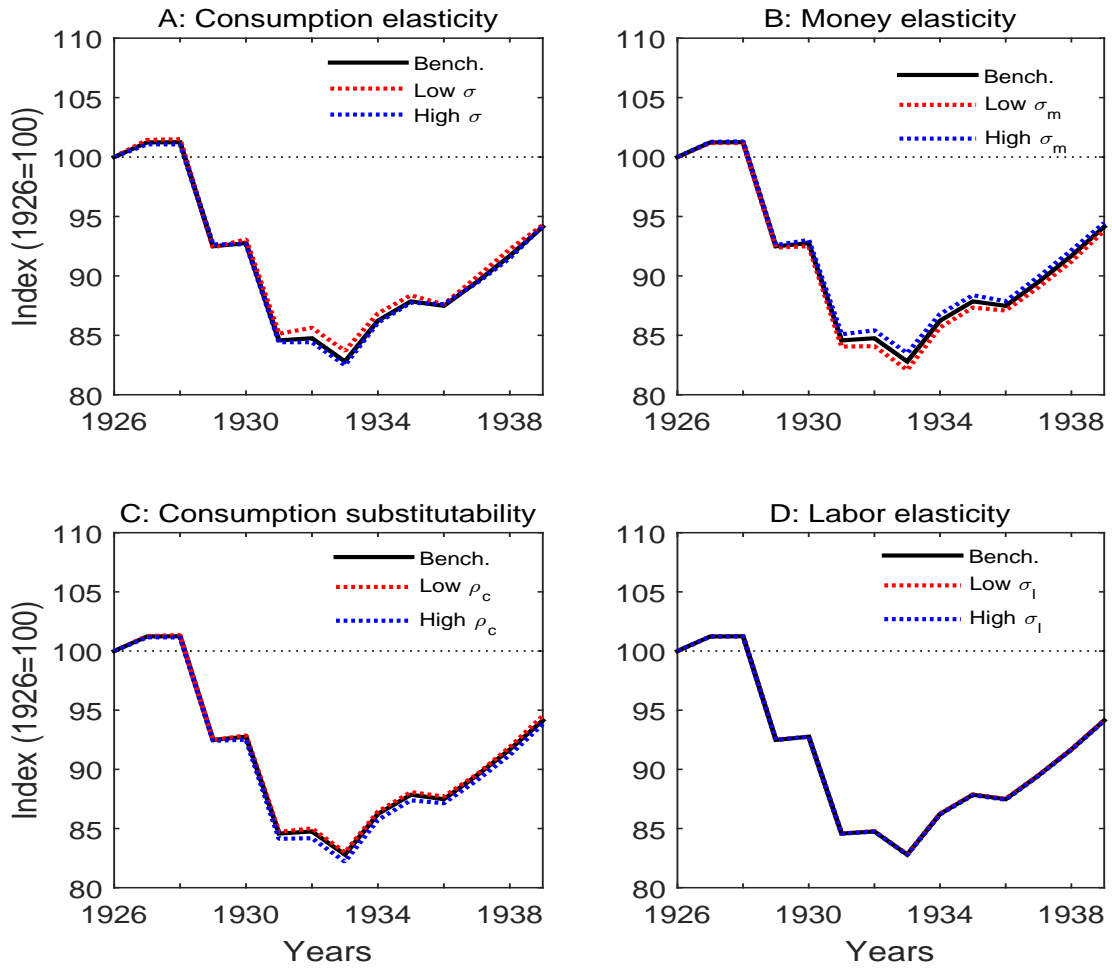
Sources: Authors' calculations

Figure 23: Output: adding monetary shocks



Sources: Authors' calculations

Figure 24: Sensitivity analysis



Sources: Authors' calculations

## APPENDIX: Data Notes

In section 2.3 we group the Miscellaneous (Sundries) Category of the Canadian COL Index as mainly nontraded. This is based on the underlying goods categories included in this sun-index, which are reported (along with their weights) in Table 4.

Table 4: Components of the Miscellaneous Category of the Canadian COL Index

Sub-Groups	Number of Items Sampled	Sub-group Weights
Medicine (drugs)	15	1.5
Household Effects	48	4.0
Furnishings	20	11.9
Tram fares	2	5.9
Telephones	1	5.9
Amusements	1	9.0
Insurance	2	10.9
Tobacco	4	9.0
Newspapers	2	2.4
Books and Education	3	1.5
Doctor	3	7.1
Dentist	1	1.8
Hospitals	4	2.4
Laundry	4	1.4
Cleaning supplies	6	1.3
Barber	3	2.7
Toilet Articles	10	1.6
Motor Operation costs	2	19.7
<b>Total</b>	132	100.0

Source: Table on page 774 of "Retail Prices of Commodities,"  
Canada Year Book 1930, ([Dominion Bureau of Statistics, 1930](#)).